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Digital Camera Overview

How Digital Cameras Work

Digital cameras and film cameras are alike in many ways: Both use a viewfinder or other device to frame the photo; in both, the image is created when light is directed through a lens at some light-sensitive device or material; and the camera cases are so similar that it's sometimes hard to tell the difference without close examination.

Electrons vs. Chemicals. The key difference lies in how light is converted into an image. In film-based cameras, the light reacts with chemically enhanced, light-sensitive grains of silver (called silver halides) arranged in three layers (to receive red, green, and blue) and suspended in gelatin on a strip of plastic.

In digital cameras, the light is captured by one of two devices: a CCD (charge-coupled device) or a CMOS (complementary metal-oxide semiconductor). The method used determines the quality of the image and the cost of the camera, but both operate similarly: A collection of light-sensitive **diodes** (the smallest of semiconductor devices which allows a flow of energy in one direction) converts light energy photons into electrons.

Measuring the CCD or CMOS sensor. The brighter the light that hits the diodes, called photosites or photodiodes, the greater the electrical charge that will accumulate at that site. The process is similar to that used in solar cells, in which semiconductor material such as silicon is struck by photons, freeing electrons and forcing a unidirectional flow.

The number of photosites, generally proportional to the size of the CCD or CMOS sensor, is directly related to the maximum resolution of the camera, measured in **pixels (picture elements**, the single dot that is the smallest element visible on your monitor). A camera advertised as 2.1 megapixels, for instance, has a sensor with approximately 2,100,000 photosites, but it produces a maximum resolution of approximately 1,600 x 1,200 pixels and a picture size of 1,920,000 pixels (1,600 multiplied by 1,200). (Note that some of the photosites are used to hold circuitry for processing and transporting the signals and are therefore blind to the striking photons.)

At this point, these electrical charges in the digital camera are analog, meaning that the output is continuous and proportional to the input. We want the discrete, noise-free qualities of digital, and to accomplish this the signal is passed to an ADC (analog-to-digital converter).

The digital output is then sent to a DSP (digital signal processor) that adjusts the detail and contrast of the image signal and compresses it before sending it to the storage unit (more on storage later).

CCD vs. CMOS: Which is better? You may have noticed that the price of digital cameras has been falling rapidly. One primary reason has been the development of CMOS sensors, which are less expensive to manufacture than CCDs; the latter require a special process to ensure high fidelity while CMOS sensors can be built using the same processes used in the production of most microprocessors.

The trade-off is quality. Each pixel of a CMOS sensor requires several transistors around it, so photons hit transistors instead of the photosite. On the other hand, CCDs consume almost 100 times the power of an equivalent CMOS sensor, drastically cutting battery life.

There's also the potential for a speed boost from CMOS because the electrical charge contained within each photosite is converted as needed from analog signal to digital signal by circuitry at each photosite. The electrical charges in CCD photosites, on the other hand, are transported across the sensor and read as a group, including charges from parts of the image that may not be needed if a digital zoom has been used to isolate a section.

CMOS sensors are more likely to be found in cheaper cameras producing lower resolutions and poorer picture quality. Look for continued advances in CMOS technology, however, that have have already combined greatly improved image quality with the lower costs of CMOS production.

Where's the color? The sensors themselves are colorblind, but there are a number of methods used to isolate colors. The most accurate is to have three separate sensors, each covered with a different filter: red, green, or blue. The resulting camera is bulky and expensive. Another method is to rotate filters in front of a single sensor, taking a series of three images; the process, though, requires that the camera remain steady during the process, eliminating its use for candid, casual shots.

A more practical approach is to place over each photosite a single filter that contains a pattern of red, green, and blue filters; the most common such filter uses the Bayer pattern, which has twice as many green sections as red or blue because the human eye detects more gradations in green.

Using this filter, four separate photosites are used to guess at a pixel's color, with an algorithm sampling some photosites more than once to determine the colors of an image area.

This educated guess is called **interpolation** and takes place in the DSP after the signals have been digitized. Though this approach is not the most accurate, it provides a reasonably good result in relatively inexpensive cameras.

Compression. It takes a lot of memory to hold images containing millions of pixels. Depending on your camera's settings, the DSP can leave the image size alone, usually generating the image as a very large (but also very accurate), TIFF (Tagged Image File Format) file; more commonly, though, the image will be saved as a JPEG (Joint Photographic Experts Group) file, in one of a set number of compression levels.

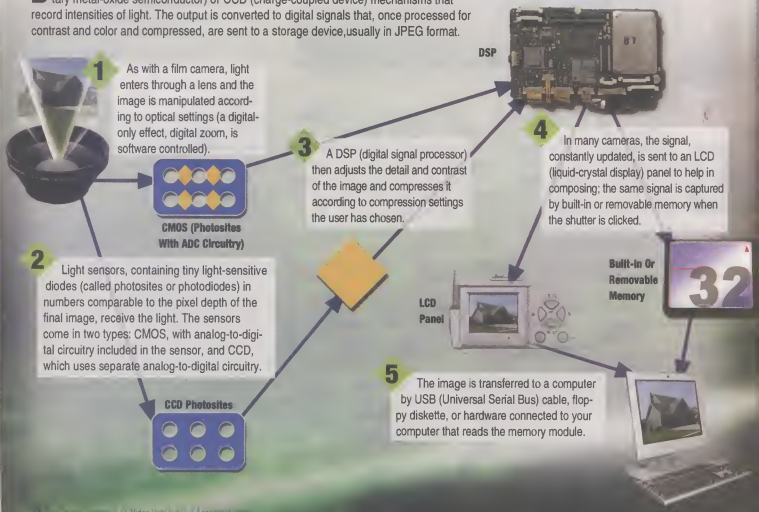
JPEGs compress by removing from the image data that the human eye often cannot see. Smaller files can thus be produced without noticeably affecting image quality. Your users manual may describe this compression in terms of **resolution**, the pixel size of the resulting image, but it is in fact a pruning of image data that gives us the specified resolution.

The advantages of this form of compression are the small file sizes and sharp images; on the negative side is the fact that data, once removed in this manner, cannot be added back to the image. Although some image formats let you change the compression without modifying the underlying image, JPEG's **lossy compression** (any compression scheme that utilizes the removal, or loss, of data) cannot be reversed.

This means that an image shot at 640 x 480 pixels cannot be changed to a higher resolution without affecting the image quality. Some low-end cameras produce supposedly higher-resolution images by using in-camera software to manipulate the image just as a software package would change the resolution, but the image quality is, as you would expect, poor.

How Digital Cameras Work

Digital cameras capture images using millions of diodes in the form of CMOS (complementary metal-oxide semiconductor) or CCD (charge-coupled device) mechanisms that record intensities of light. The output is converted to digital signals that, once processed for contrast and color and compressed, are sent to a storage device,usually in JPEG format.


DSP
1
As with a film camera, light enters through a lens and the image is manipulated according to optical settings (a digital-only effect, digital zoom, is software controlled).
CMOS (Photosites With ADC Circuitry)
2
Light sensors, containing tiny light-sensitive diodes (called photosites or photodiodes) in numbers comparable to the pixel depth of the final image, receive the light. The sensors come in two types: CMOS, with analog-to-digital circuitry included in the sensor, and CCD, which uses separate analog-to-digital circuitry.
CCD Photosites
3
A DSP (digital signal processor) then adjusts the detail and contrast of the image and compresses it according to compression settings the user has chosen.
4
In many cameras, the signal, constantly updated, is sent to an LCD (liquid-crystal display) panel to help in composing; the same signal is captured by built-in or removable memory when the shutter is clicked.
LCD Panel
Built-in Or Removable Memory
5
The image is transferred to a computer by USB (Universal Serial Bus) cable, floppy diskette, or hardware connected to your computer that reads the memory module.

Memory cards come in a variety of sizes and let you save digital images to a portable medium.

Photo courtesy of AGFAnet, http://www.AGFAnet.com - My Photo Printing Portal.

Most digital cameras use a variation of the JPEG format called Exif (Exchangeable Image File) that was developed by the Japanese Electronics Industry Development Association. This format allows the saving of additional information (called **metadata**) with the image, such as sound and picture-taking conditions, date and time, camera settings, etc.

Storage. The images need to be stored somewhere before they can be downloaded to a computer or a printer. Inexpensive cameras may have only built-in memory that cannot be removed or updated. Removable memory is far more popular, because the storage units can be removed and stored, replaced, and upgraded for larger-capacity units.

Storage is one area where camera makers have yet to settle on one standard. Instead, several standards have come into use, including SmartMedia memory modules, which usually come in sizes ranging from 4MB to 128MB; CompactFlash, offering slightly larger sizes (up to 168MB); Memory Stick, a proprietary module used by Sony; standard floppy diskettes, which hold about 1.4MB; removable hard drives in the form of cards, with storage space up to 1GB; and built-in writeable CD and DVD drives, capable of holding several gigabytes.

Getting it out of the camera. Although by using large removable storage units you can retain several images, you'll eventually want to download your photos to your computer, where you can edit, print, or email them, and store the final image in a more permanent location.

A USB (Universal Serial Bus) connection is fast and easy to use, though it requires a USB port (standard on newer computers). The older serial connection is slow but works on older computers as well as new. For cameras that record to floppies, you can simply put the diskette in your computer's floppy drive in order to copy the image to the hard drive. Also, if you're using some kind of memory module, you can install hardware on your computer that lets you remove the module from your camera and load it directly to your computer.

Exposure. Regulating light is just as important in digital cameras as in film cameras. Beyond a certain point, photosites will be saturated with light and cannot give an accurate measurement.

As in a film camera, aperture and shutter speed are used to control the amount of light that reaches the image-recording medium. The **aperture** is the size of the opening in the camera lens, while **shutter speed** is the length of time the aperture remains open.

In many digital cameras, the shutter speed is handled by resetting the sensor, rather than by using an actual shutter mechanism. Some digital cameras handle speed and aperture settings automatically, but many more advanced models allow the use of manual settings.

Autofocus and focal length. Most digital cameras provide autofocus using either active or passive approaches. **Active autofocus** utilizes infrared signals that bounce off of objects within the camera's field of vision and return to the camera, which then calculates distance and sets the focus accordingly. Unfortunately, the infrared signal may bounce off an object in front of the subject and put the subject itself out of focus.

In **passive autofocus**, the camera's processor analyzes the contrast of picture elements, "seeing" the image as you would and thus avoiding the pitfalls of active autofocus. However, the passive approach works only when is there is adequate light and enough contrast in the image to allow the necessary calculations.

Focal length is the distance between the lens and the surface of the sensor. The longer the focal length, the closer an object appears to be. The surface of a film sensor is much larger than that of a digital sensor, so relative focal lengths are shorter in digital cameras. To allow comparisons, digital camera makers generally advertise their camera's focal length in relationship to a 35mm film camera's focal length; for instance, a 54mm focal length for a digital camera may be equivalent to a 35mm lens on a 35mm film camera.

Zoom. A zoom lens modifies the focal length of the lens, moving the view forward or backward. There are two methods currently used: In less expensive cameras, a **digital zoom** uses software to enlarge a portion of the image by selecting only a portion of the pixels available and interpolating to add detail, just as if you'd opened the image in image-editing software and increased the size of the image; because the camera is working with limited data, the result can be fuzzy.

Optical zooms, however, use motors to physically change the focal length of the lens. The magnified image is spread over the entire sensor, using all of its photosites, and thus presents a much sharper zoomed image. This approach, although much more accurate, is also more expensive; the camera must include a movable lens, a motor to move the lens, and some sort of button or switch combination to control the movement.

Getting a preview. Few consumer-level digital cameras have a true SLR (single lens reflex) viewfinder with which to see the image exactly as the light sensor sees it. Instead, the typical viewfinder causes you to see the scene from a slightly different angle. To present a more accurate view, most digital cameras offer an LCD (liquid-crystal display) preview that is constantly updated by the light sensor. LCDs, found in clock faces and notebook displays, are a type of crystal in a near-liquid state that reacts to electric current by changing shape; the areas of the changed shape form the image displayed on the LCD.

These displays have battery-powered backlighting and sometimes swivel so that they can be viewed from different angles, allowing, for instance, the shooting of self-portraits.

■ **A Changing Technology.** How digital cameras work may change dramatically in the future, as scientists refine sensors, storage, processors, and lenses. You can expect to see resolutions closer to those provided by film cameras, with most experts indicating that a digital camera with a true resolution of 7 megapixels would essentially be equivalent to the resolution offered by film. Also, expect to see a continued blurring of the lines between "still" and video cameras: About half of the still cameras introduced last year supported the recording of short video clips, and the ability to record video on your so-called "still" camera will no doubt increase as imaging and storage technologies both continue to improve. In the end, there may be very little difference between a digital still camera and a digital video camera. LS

by Iver Davidson, Ph.D.

A Place For Your Stuff

Digital Image Storage Options

Imagine a world of instant gratification, where images are captured instantly, reproduced perfectly, and sent around the world in seconds. Today's digital cameras have brought this vision within the grasp of many consumers. Kodak founder George Eastman believed that the success of consumer photography depended upon affordable film, and his prescience founded an entire industry. Fortunately, the digital camera business has taken this lesson to heart, and the availability of inexpensive storage is the key to this burgeoning industry.

However, with the benefits of the digital revolution come a burden: There is a vast array of storage media to choose from, ranging from magnetic and optical discs to solid-state devices. Although choosing the best media for your needs can be daunting, we'll help you decipher the code media manufacturers use. As comedian George Carlin would say, all you need is "... a place for your stuff."

A Pixel Here, A Pixel There. With the resolution of today's cameras increasing with each new generation, the first step in understanding storage media is estimating how much space digital images require. The most significant factors in determining how much storage space you'll want are your camera's resolution, the bit depth of your images, and the compression factor.

Megapixels. Most digital cameras tout their resolution in terms of megapixels, with a megapixel being equivalent to 1,048,576 pixels. Pixels are the building blocks of your images, and the total resolution is calculated by multiplying the number of horizontal and vertical pixels. For example, an image that has 1,280 horizontal pixels and 1,024 vertical pixels would have a resolution of 1,310,720 pixels. Dividing this by 1,048,576 results in a 1.25 megapixel image. So far so good. All things being equal, the higher the pixel count, the sharper your images will be.

Bit depth. Digital images store color and tonal data in channels, denoted by the number of bits used to store that information. An image stored in RGB (red, green, blue) format for display on a computer monitor requires 3 bits. Images intended for print utilize CMYK (cyan, magenta, yellow, black), which requires 4 bits. Finally, grayscale images with no color require just 1 bit. The amount of space in bytes required by an image is calculated by multiplying the pixel count and the bit depth. In our previous example, we had 1,310,720 pixels. To store an RGB image of this size would require 3,932,160 bytes of disk space. (In other words, pretty close to 4MB.)

Compression. Before you panic over the number of bytes needed to store a single image, remember that most camera manufacturers let you compress your images. Depending on the compression algorithm used, you may be able to shrink your images by up to a factor of 20, but a safe estimate is a 5:1 compression ratio; thus, in our previous example, a 5:1 compression rate would reduce our storage requirement to 787,032 bytes, or 750KB. Note, though, that compressing an image usually results in a loss of image fidelity. If you're seeking the utmost in image clarity and quality, save your images in an uncompressed format.

A Baker's Dozen. Almost. Camera manufacturers have long known that the devil is in the details, and the digital camera arena is no different than its older, low-tech sibling. Unfortunately for the consumer, this means navigating through a bevy of storage options. Although we counted 11 potential candidates, the good news is that they break down into four distinct categories. We'll take a look at magnetic media, optical discs, flash media, and a Lilliputian hard drive. Depending on your usage, each of these formats has a place in your camera's arsenal.

CompactFlash cards balance size, speed, and durability at a hard-to-beat price.

Use of flash memory to store your images means SmartMedia cards can be thinner than the CompactFlash format.

An oldie, but a goody. The first storage medium we'll consider is the venerable floppy diskette. Despite attempts by computer manufacturers to kill off what most see as an archaic storage device, the 3.5-inch floppy is a true survivor. With the exception of Apple products, most personal computers still ship with a floppy drive. This ubiquity has encouraged Sony to use the floppy for storage on several models of its digital cameras, known as FD Mavicas. With a capacity of 1.44MB, a single floppy won't hold many high-resolution pictures, but the media are available almost everywhere in the Western world, and transferring images to your computer is simple. Unfortunately, there are numerous downsides, primarily the speed of floppy drives and the reliability of the media. Because the disk itself is a piece of plastic coated with iron oxide, it is susceptible to any magnets that may be nearby, and any sufficiently strong magnet will wipe out the contents of the disk. Also, the 3.5-inch drives in these cameras require more power than other storage methods and can't write to the disk very quickly. This delay is known as lag, and if you are frequently shooting action shots, you may want to skip any camera that relies solely upon floppies. (Sony has largely recognized the need for a supplement, and most Mavicas now also utilize Sony's Memory Stick media.) Despite their low per-disk cost, floppies are actually more expensive than more efficient storage media.

Disk redux? Panasonic pursued the same strategy as Sony, but with a twist. When Imation introduced the SuperDisk with a capacity of 120MB, Panasonic embraced it in its SuperDisk PalmCam series. Similar to the traditional floppy, the SuperDisk drive is a magnetic storage device that can write to a 120MB disk, as well as utilize 3.5-inch floppies. Although the greater capacity is a leap past the older floppy, the SuperDisk suffers from the same lag problems as its ancestor. Additionally, Imation has discontinued production of the SuperDisk drive. This, coupled with the lack of the SuperDisk's success in the PC storage arena, might lead to shortages of the disks themselves. If you decide to purchase a PalmCam, stock up on the disks before they become scarce.

Storage Media Types & Capacities

Here's the rundown of available storage media and their sizes and how much data each type can hold.

Media Type	Dimensions	Current Capacity
Compact Flash I & II	43mm x 36mm	8MB to 1GB
SmartMedia	47mm x 37mm	8MB to 128MB
CD-R & CD-RW	3-inch discs	156MB to 185MB
Floppy Diskette	3.5-inch disk	1.44MB
SuperDisk	3.5-inch disk	120MB
Microdrive	1 inch square	340MB to 1GB
Memory Stick	22mm x 50mm	8MB to 128MB
MultiMedia Card	32mm x 24mm	8MB to 64MB
SD Card	32mm x 24mm	8MB to 256MB
PC Card	85mm x 54mm	8MB to 1GB

Sony loves the CD. Sony has always had a justifiable love affair with the compact disc format; with the advent of recordable CD-ROMs, the company quickly leveraged the format into a storage device for its line of digital cameras. CD Mavicas utilize a 3-inch recordable disc that can store as much as 156MB. Other disc vendors have pushed the format to 185MB, and 210MB is on the horizon. With discs now available for less than $1, the CD-R (CD-recordable) format provides tremendous bang for the buck. You can also use CD-RW (CD-rewriteable) discs in these cameras, though the rewriteable discs do cost more than the CD-R discs. Among the downsides are a slightly slower write time than other media and a larger camera size to accommodate the disc and drive mechanism. The increased number of moving parts compared to other devices may lead to a greater incidence of mechanical breakdown. Finally, these drives tend to require more battery power than solid-state devices such as the PC Card and CompactFlash cards discussed below.

No flash in the pan. In 1994, a California company named SanDisk invented the CF (CompactFlash) storage device. Instead of using a magnetic oxide (as in floppy and SuperDrive disks) to store digital data, CF devices are solid state, with no moving parts. Composed of banks of transistors, CF cards transfer data quickly, require low amounts of electrical power, and have a small form factor. According to Craig Rotbert, SanDisk's CF product manager, "The primary benefits of solid-state devices and CompactFlash over other storage media are the very fast read/write times, as well as low power consumption and a rugged design. A CompactFlash card can withstand a 2,000G force impact, while other media can only tolerate a fraction of that."

CF cards incorporate a memory controller onto the card itself, letting the camera communicate with the card without worrying about how to manage the data itself. CF cards come in two configurations, CFI and CFII (also occasionally referred to as CF1 and CF2): CFI cards can be used with an adapter to fit into CFII slots. Roughly the size of a matchbook, these reusable cards have become the benchmark for digital storage. Current capacities range from 8MB to 1GB, and SanDisk reports that CF storage should reach 2GB by the end of 2002.

Not so smart. Invented by Toshiba, the SmartMedia card is a bit of a misnomer. In contrast to CF's onboard memory controller,

If your camera uses a PC Card, you can transfer your images directly from your camera by removing the card from the camera and inserting it in your notebook computer.

the SmartMedia card is just an array of memory modules that rely upon your digital camera to perform memory management. As with most memory devices, there are benefits and drawbacks to SmartMedia. The simplicity of the card makes it thinner than the CF cards, and the physical interface is simplified. The downside is that by requiring your camera to manage the memory, you may be locked into a specific size capacity; for example, if your camera only knows how to address a 128MB card, when larger cards arrive, it may not be capable of using them. Also, the SmartMedia card uses an exposed pin interface that can lead to damage caused by ESD (electrostatic discharge). The current capacities for SmartMedia cards range from 8MB to 128MB. By the end of 2002, they should be available in 256MB sizes.

PCMCIA. Notebook computer owners have long known that the PCMCIA (Personal Computer Memory Card International Association) format lets them quickly and easily add modems, network adapters, and other peripherals to their computers. With the advent of affordable flash memory, professional-grade digital cameras quickly adopted the format for high speed, high capacity storage. For professionals, affordable is a relative term: The PCMCIA card format is one of the most expensive we found. As the capacities of other storage formats have risen, the PCMCIA card has slowly become less popular with pros, although it currently offers the largest capacity, at 2GB.

Forget me not. As a true pioneer in consumer electronics, Sony has often chosen the road less traveled in their choice of storage devices. The company's Memory Stick is a good example of this. Utilizing the same flash technology as the other solid-state devices we've examined, the Memory Stick is Sony's attempt to provide a world of seamless digital storage for cameras, PDAs (personal digital assistants), Walkman devices, and notebook computers. The biggest advantage of the Memory Sticks is their compact size, roughly 5 cm x 2 cm. The Memory Stick also includes a write-protection lock that physically prevents you from accidentally overwriting your images. Another benefit of Sony's design is the reduction in the number of interface pins or contact points. The CF card interface discussed above has 50 pins that can be bent out of alignment if you aren't careful; in contrast, the Memory Stick has only 10 contact points. If you swap out your media frequently, the Memory Stick may prevent you from damaging your camera. The downside to this is that CF cards can transfer data at a faster rate. In terms of capacity, the Memory Stick currently tops out at 128MB, though 256MB Memory Sticks should arrive in late 2002.

SD and MMC. Following the trend in miniaturization are two cards that share the same form factor, the MMC (MultiMedia Card) and the SD (Secure Digital) Card. The size of a postage stamp, these cards have 7- and 9-pin interfaces, respectively. Most devices that support SD cards can also use the MMC, but the reverse isn't true. SD incorporates SDMI (Secure Digital Music Initiative) copyright protection technology. Used mostly in Kodak and Minolta cameras, the two cards don't have as much capacity as the CF cards, though they provide more space than the comparable Memory Stick. The highest current capacity for the MMC is 64MB, and the SD card tops out at 256MB.

Sony has its own proprietary flash format that can be used in Sony PDAs (personal digital assistants), as well as in the VAIO line of notebook computers.

Brought to you by Gulliver. After taking a look at IBM's Microdrive, you may wonder if Big Blue has hired a factory full of Lilliputians to build what is arguably the world's smallest hard drive. Measuring approximately 1 inch square, the Microdrive utilizes the same technology as your computer's hard drive, but on a smaller scale. Compared to its bigger brethren, the little Microdrive is a bit slower, with a seek time of 15ms (milliseconds) and a rotational speed of 3,600rpm (revolutions per minute). (Typical hard drives sport seek times of less than 12ms and spin at 5,400rpm or more.) Microdrives range in capacity from 340MB to 1GB and can be used in many cameras that support CFII media. Be sure to check with the camera manufacturer to see if you can use the Microdrive. Some issues to keep in mind with Microdrives are a greater sensitivity to shock, higher power requirements than flash media, and slower transfer rates.

An amazing technical feat, IBM's Microdrive requires more delicate treatment than do solid-state storage devices.

The postage stamp-sized Secure Digital Card includes copyright protection features.

The Future: Cheaper, Faster, Better. If the resolution of digital cameras increases at the current rate, today's storage media will be hard pressed to keep up. Another factor that will push storage requirements is the blending of still digital photography and digital video. Many still cameras today also have a video recording capability that consumes storage space at a prodigious rate. However, some technologies on the horizon offer hope. Improved manufacturing processes should enable flash memory cards to keep pace with growing storage demands, and the introduction of the DVD as a storage device for Hitachi's DVD Cam should eventually cross over into the digital camera world. Luckily for you, the lack of a dominant media standard has led to fierce competition for your storage needs and a resulting drop in cost. LS

by Chris Jackson

What Really Matters?

Features To Look For In A Digital Camera

In the final analysis, what's really important? What really matters? No, we aren't talking about deep philosophical questions. We're tackling a much more important issue: choosing a digital camera. When you hit the stores, you need to know what you're looking for. If you aren't prepared, the array of digital camera options can be bewildering. And once you understand what each specification and setting actually does, you need to spend a little time figuring out which ones matter to you. Deciding on price alone is dangerous. You may find yourself stuck with a cheap camera you can't put to use or you may just as easily waste your hard-earned money on (equally useless) superficial bells and whistles. But by taking just a little time to assess your needs and learn about digital camera features, you can sort out your priorities and define exactly what matters to you. Now that's deep.

Examine Your Motives. The first step is to decide why you want a digital camera. What do you want to do with it? Do you simply want to take snapshots, store them on your computer, and share them via a personal Web page? Are you producing images for professional or small-business Web sites? Do you plan to print images? If so, will you produce personal photos for family and friends or professional images for brochures or newspapers? The answers to these questions will determine which features are important and which aren't. The smaller your images, the lower your resolution (and the cheaper your camera) can be. Similarly, the standards for Web-quality images are much lower than for print-quality. And quality is generally more important for professional than for personal uses. Where do you anticipate shooting? If you are going take outdoor photos in a variety of weather conditions, you will have different considerations than someone taking snapshots of birthday parties and anniversaries. How long will you be using your camera per session? Cameras that are more robust use more juice but also tend to have longer-lasting and more powerful batteries. Using the LCD (liquid-crystal display) screen to frame your shots will take more power, as will capturing video or making use of other special features. Make sure you consider battery life and the price of replacements.

The Feature Follies. Once you've defined your objectives, you're ready to do some research. You may find it helpful to make a list of all the features we'll discuss here and others that you run across. Check off those that are important to you. Use this cheat sheet when comparing cameras; you'll save time and effort by employing the process of elimination. Taking an objective and measured approach to buying a digital camera will help you separate real information from all the hype. Ignore the latest buzzwords and marketing superlatives. Instead, look for quantifiable, measurable information. Keep in mind the mantra of skeptics everywhere: "In God we trust; everyone else, bring data."

Here are 10 digital camera features that you will hear a lot about. If you understand what each means, and (more importantly) what each means to you, you'll be ready to make a well-informed decision.

Image resolution. One of the most basic ways to judge a camera is by the quality of its pictures, and the simplest gauge of a camera's quality is its megapixel rating. Megapixels refer to the number, in millions, of **pixels** (picture elements) that the camera's sensor can capture per image. Even low-end cameras can capture up to 1 megapixel, creating images with resolutions of up to 1,152 x 864. Though you may find some cameras with lower resolutions, the price difference usually won't be worth the sacrifice in image quality. Current high-end consumer cameras capture 5 megapixels or more. Remember that the megapixel and resolution specifications published for digital cameras are maximums. You can set your camera to capture images at lower resolutions in order to conserve space and battery power, but don't pay for more resolution than you will use. Image resolutions typically range from 320 x 240 to 2,560 x 1,920 or higher. However, anything less than 640 x 480 will probably be insufficient even for Web publishing and anything greater than 2,048 x 1,536 will probably be overkill unless you plan to print posters. It may help to think about your PC Desktop when trying to visualize image resolution. If your monitor were set to a resolution of

800 x 600 pixels, an image of that resolution would cover the full screen. This is sufficiently large for pictures aimed at a Web audience, but you will find that images printed at that resolution would generally be of poor quality.

Lens selection. The lens is your camera's window on the world. It only makes sense, then, that your choice of lens will affect the quality of your images and your options as a photographer. Some cheap digital cameras try to get by with plastic lenses. Glass will always provide a better picture and is more durable, so make sure you get a camera with a glass lens. You should also pay attention to several lens-related measurements. **Focusing distance** is a measure of how close you can get to your subject. (Some cameras include a macro mode, letting you get within inches of the subject.) **Focal length** defines the breadth of your field of vision. This is important in determining how wide or narrow your shots can be. The smaller the focal length (measured in millimeters), the wider your field of vision. The focal length of the human eye is about 50mm; lower focal lengths create wide-angle views and higher lengths, with a narrower field, generate telephoto shots. Bargain digital cameras will often have fixed, wide focal lengths. This can make it difficult for you to frame shots well. Look for a camera with at least a 35mm equivalent length, if not an adjustable focal length. Some models also have the capability of switching or adding lenses. **Add-on lenses** simply attach over the top of the default lens, modifying the view. **Interchangeable lenses** actually swap out with the default lens, providing greater control and truer settings; these are found on more expensive cameras. Intermediate users may find manual lens controls useful, letting you adjust for unusual lighting conditions, for example. Unless you're very serious about your photography, though, and plan to spend a bunch of cash on extra lenses, the ability to add on or exchange lenses will be wasted.

Zoom. There are two kinds of zooms on today's digital cameras. You'll see cameras with digital zooms, cameras with optical zooms, and cameras with both kinds. A **digital zoom** merely magnifies an existing picture, zooming in on a portion of the already-captured image. Unfortunately, this process doesn't entail any corresponding improvement in image resolution or detail. In fact, if you have ever used the magnifying glass tool in an image viewer to zoom in on an on-screen picture, you know that image quality degrades as you blow a picture up; in effect, that's what a digital zoom does. An **optical zoom**, on the other hand, is a true zoom that provides sharper detail and greater resolution for faraway subjects. Some cameras let you combine optical and digital zooms to maximize telephoto capabilities. In any case, don't bother with a camera that doesn't have some level of optical zoom. Even if your shooting is limited to vacation and party snapshots, you will find plenty of situations when a zoom will come in handy. And very basic optical zoom models (a 3x zoom is fairly standard) don't cost much more than those without optical zooms. If you plan to do long-range shooting, you can pay for more powerful telephoto capabilities. Advanced models go up to 14x and beyond.

Flash. Obviously, if you're going to take picture indoors or at night, you will need to look at cameras with a flash. You should also be aware of several related features. Many cameras will let you control the flash with on/off/auto options. Most users will find the ability to switch between these settings useful. Built-in red-eye prevention is also common; this will be a valuable tool if you plan to take snapshots or candids with human (or animal) subjects. Some models include a preflash, performing a quick test flash and then adjusting their settings based on how the flash will affect the image. Advanced models will let you synchronize the built-in flash with a detachable one of your own. The standard flash settings will suffice for most users. If you don't plan to buy external flashes, don't pay for the ability to add them.

Storage media type. There are a variety of storage media for you to choose from. Though some older models use floppy diskettes or built-in memory, newer digital cameras store images on media cards or sticks until you transfer them to your PC. CF (CompactFlash) is the most commonly used digital camera media. CF cards are small (about the size of a matchbook) and can hold up to 512MB of data, but most of the time CF cards come in denominations of 32MB, 64MB, or 128MB. SmartMedia cards are similar, though smaller and faster than CF, but have a lower maximum capacity of 128MB. CompactFlash is also portable

Digital Camera Feature Matrix

Use this simple chart to help you decide which features are most important to you, based on your needs. Research only cameras that meet your requirements, but don't pay for features you neither want nor need.

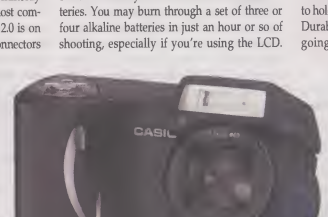
	Basic	Intermediate	Advanced
Resolution			
1-2 megapixels	X		
3-4 megapixels		X	
5+ megapixels			X
Lens			
35mm equiv. focal length	X		
Adjustable focal length		X	X
Add-on and detachable lenses			X
Optical Zoom			
3x	X		
5x		X	
10x+			X
Flash			
On/Off/Auto/Red-eye	X	X	X
Preflash		X	X
Sync with external flash			X
Image Transfer			
USB	X	X	X
Serial/Parallel	X	X	
Infrared/Bluetooth			X
Power Source			
Alkaline	X		
NiMH	X	X	
Lithium-ion		X	X
Manual Controls			
Manual focus		X	X
Shutter speed		X	X
Aperture		X	X
Speed Of Recovery			
10-20 seconds	X		
1-10 seconds		X	
Burst mode			X

across more devices: CF cards will work in a wider variety of cameras, handheld computers, and music players. Sony's digital cameras use the company's own proprietary Memory Stick technology. The benefits of each format vs. the others are debatable. However, CF cards are thicker and more rugged than SmartMedia cards. If you find yourself roughing it a lot, you may appreciate that durability. Otherwise, unless you have other devices that use one standard or another, don't make media type a big part of your decision. Do, however, make sure you pay attention to the number and size of cards that come with each camera; many manufacturers provide only a single 8MB card. 64MB spares cost between $25 and $50. It's not a bad idea to plan on purchasing a spare card or two anyway; you want to make sure that you have enough storage for your photo shoots. One-megapixel images usually compress to about 200KB in size, so you can expect to fit only about 36 shots at that resolution on an 8MB memory card. A 128MB card (available for about $70), on the other hand, will hold almost 600 1-megapixel images.

Most digital cameras use CompactFlash or SmartMedia cards. All else being equal, choose the media that is compatible with more of your devices.

Image transfer. Pay attention to how cameras transfer images to your PC, and only consider products compatible with your hardware. Many cameras connect via a USB (Universal Serial Bus) connection. USB is fast, hot swappable (you don't have to reboot when you connect a USB device to your computer), and commonly found on newer PCs. USB 1.0 is the most commonly implemented version, but USB 2.0 is on the horizon. If you don't have USB connectors on your PC or are concerned about conflicts with other USB devices, look for cameras that connect via serial or parallel ports. Serial connections are slower than USB and require a reboot when you hook them up, but they may work better on older machines and save you a few bucks in the process. Many models support multiple connection types: USB and serial, for example. If you find yourself taking quite a few pictures and storing them on multiple media cards, you should invest in a card reader. These devices stay plugged into your PC: You just remove the card from the camera, insert it into the reader, and transfer images. With a reader, you don't have to connect the camera to the computer at all. Higher-end cameras may be capable of transferring via infrared or Bluetooth technologies. Whatever the transfer method, make sure that you have compatible hardware. Although infrared and Bluetooth devices offer the convenience of wireless connectivity (some cameras will even transmit images wirelessly directly to compatible photo printers, bypassing the PC entirely), most users will find that the cost savings and speed of old-fashioned wired transfers are more attractive.

Power source. Ignore power at your peril. When concentrating on megapixels, zooms, and media cards, it's easy to forget about what makes all those nifty features run. Quite a few cameras still rely on standard AA alkaline batteries. You may burn through a set of three or four alkaline batteries in just an hour or so of shooting, especially if you're using the LCD.



Whatever digital camera design you prefer, make sure the camera fits your hand comfortably and that its controls are easy to use.

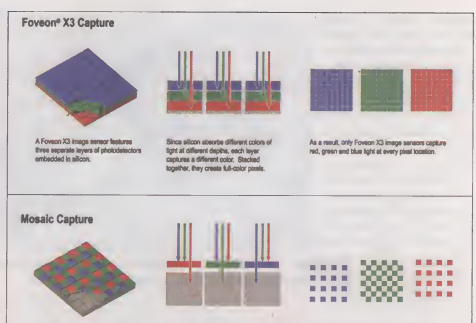
You can always buy rechargeable batteries and a charger, but you're likely to get a longer life span out of NiMH (nickel-metal hydride) or Li-Ion (lithium-ion) batteries. You generally get longer life and more power as you go up in price. This is where TOC (total cost of ownership) rears its ugly head: What's the point of saving money on film only to turn around and spend it all on batteries? Check the expected lifetime of each camera you're considering, using its standard power source with all its features running. Compare that with how often (and for how long) you expect to use your camera. Most users will find that, over time, they will save money by spending a little more up front for a camera with a better battery. Look especially for cameras that let you combine battery types. Remember that some cameras also come with battery chargers.

Styling. Another easily neglected consideration is styling. This is an exception to the rule of quantification. You can't easily measure comfort, ease-of-use, or durability, but style is important. And we aren't just talking about looking cool, although that's nice, too. The more features packed into a camera, the larger it will be. How a camera feels in your hand, its heft, and the positioning of buttons and controls will all impact your shooting. Make sure that you are comfortable holding and shooting with your camera. Strike a balance between heavy enough to hold steady and light enough to carry around. Durability is important as well: Is the camera going to break the first time your daughter knocks it off your desk? Also pay attention to the ease with which you can shoot, zoom, make manual adjustment, and navigate the on-screen menus. How intuitive is the actual taking of pictures? How easy is it to change settings or access various options? Styling is largely a matter of personal preference, so give each camera on your list a test run before making a purchase.

Advanced Features. The final features that we'll discuss will appeal mostly to more advanced users. Beginners would do well to

The Foveon Chip: Digital Camera Resolution Cranks Up

Are you convinced that 5 megapixels is more resolution than you'll ever need? Well, the resolution situation is about to get much more complicated. Foveon, a Santa Clara, Calif., company (http://www.foveon.net), has developed a new type of sensor for digital imaging (with applications in both photography and video). This technology, called the X3 system, lets each pixel captured by the sensor record levels of all three primary pixel colors, rather than just one. Normal image sensors piece together single-colored pixels in a mosaic, each in essence tricking the eye into thinking it sees a broad range of colors and fine detail. Foveon X3 technology, by letting tri-color information be captured by each pixel, improves detail and image quality dramatically, cutting down the amount of guesswork the eye has to do in order to render the image. The technology promises to triple image resolution while improving power and processing performance, since the camera will have to do less work in order to create an equally accurate image. Of course, cameras using the Foveon X3 chip aren't yet commonplace, and you can plan to spend at least $3,000 to get one. But rest assured that, with time and an ever-increasing demand for high-resolution digital cameras, you'll soon be buying a 15-megapixel camera with a Foveon sensor. And you thought 5 megapixels was cool. □


Foveon® X3 Capture
A Foveon X3 image sensor features three separate layers of photodetectors embedded in silicon.
Since silicon absorbs different colors of light at different depths, each layer captures a different color. Stacked together, they create full-color pixels.
As a result, only Foveon X3 image sensors capture red, green and blue light at every pixel location.
Mosaic Capture
In conventional systems, color filters are applied to a single layer of photodetectors in a tiled mosaic pattern.
The filters let only one wavelength of light—red, green or blue—pass through to any given pixel, allowing it to record only one color.
As a result, mosaic sensors capture only 25% of the red and blue light, and just 50% of the green.

The new Foveon X3 system replaces the "mosaic" model of previous image sensors, which can only capture one color per pixel.

Graphic courtesy of Foveon

be aware of these options, though, if for no other reason than to avoid paying for superfluous bells and whistles.

Manual controls. As digital cameras become more powerful and less of a novelty, manufacturers are adding manual controls in order to provide serious users with greater flexibility. Basic models emphasize usability and automate focus, shutter speed, and aperture size for you. More advanced models, however, give you more control over these crucial features. If you are unhappy with the way automatic focus makes composition decisions for you, look for a camera with a manual focus option. **Shutter speed** measures how long the shutter stays open, thus exposing the sensor to light. Adjusting shutter speed (in tandem with other settings) makes both fast-motion and time-lapse photography possible. A shutter that is too slow will blur images in motion and can **overexpose** your photos (make them too light). A too-fast shutter can create **underexposed** (too dark) pictures. The important measurement for cameras with an adjustable shutter speed is the available range. A maximum speed of 1/1000 of a second will provide decent motion capture capability, and 1/10 of a second should let you shoot in low-light, nonmotion settings as long as you use a tripod. Keep in mind that anything shot by hand at slower than 1/25 of a second will probably be blurry, so if you don't plan to use a tripod don't pay extra for a camera with a broader range. A manual f-stop lets you control the size of the **aperture** (the hole through which light enters), adjusting for lighting conditions, shutter speed, and depth of field. If you are comfortable adjusting these settings, look for a camera that offers the flexibility of manual controls. If not, don't waste money on extra features you won't use.

Onboard editing. Many manufacturers try to differentiate their products from the competition by touting their onboard editing features. Almost all digital cameras now come with an LCD, helping you frame your shots before you take them and letting you see the results immediately. Some screens distort resolution and color more than others, though, so don't rely on them too much. Perhaps the most important function of the screen is the ability to scroll through your shots and remove the ones you don't want. This clears up storage space and saves you time transferring files. Investigate the ease with which you can sort through your images on any camera you're considering. You can also find cameras with TV and slide show formatting options, built-in compression, short video capabilities (with or without sound), image cropping, voice annotation, and other tools. Such features can be fun to play with, but most of these functions are handled more effectively by other devices and dedicated applications. Avoid paying extra for these frills unless you have a specific need for them.

■ **Focus On Features That Matter.** The universe of digital camera functions is constantly expanding. By maintaining focus on the features that really matter to you, however, you can avoid becoming overwhelmed and find a digital camera that's right for you. Now that's what really matters. LS

by Gregory Anderson

Digital Superstars

The Top Digital Cameras

So you've decided to take the plunge into digital photography. Your timing couldn't be better; the number of camera manufacturers and the models they offer has expanded to meet a burgeoning demand for the instant gratification of digital imagery. Unfortunately, this cornucopia of cameras can leave you feeling a bit out of focus. If you feel queasy about making a bad buying decision, fear not. In this article, we've sliced the market into three categories, diced them down to your best options, and selected our "Editor's Pick" for each category.

■ **A Camera You Can Love.** OK, maybe that's reaching too far, but we hope that the camera you choose is one you enjoy using, helps create great images, and doesn't send you to bankruptcy court. The key is in setting your sights on the appropriate camera for your needs. Otherwise you'll either end up paying for unneeded features, or you'll eventually find that the camera doesn't meet your needs.

An important idea to bear in mind is that digital cameras aren't as mature as their film-based cousins. After all, digital photography is a relatively new industry, especially when compared to the hundreds of years film has endured. Each year a new generation of cameras arrives on the market, with capabilities that surpass their predecessors in price, performance, or both. This trend is similar to what computer buyers experience, but don't let it distract you from buying the appropriate camera for your needs. Otherwise, the urge to buy the most advanced camera will lead you to spend more money than necessary. And an important side benefit of the rapid growth and competition in the digital camera market is the corresponding drop in prices we see as new technology is introduced.

■ **What Do I Need?** The first step in selecting the appropriate camera is determining how you plan to use it. We've broken the market down into three categories: entry level, prosumer, and professional. Although you may think that a particular camera is unsuited to your requirements, examining each camera's features may lead you to revisit how you intend to capture your images.

Entry-level cameras. As a starting point for exploring digital photography, most entry-level cameras sport megapixel resolutions, automatic controls, and compact designs. The images these cameras can capture are suitable for use in Web pages, as attachments sent through email, and for small prints if image quality isn't an overriding consideration. All the cameras we reviewed in this category use the USB (Universal Serial Bus) interface for transferring images to your computer. We've put a price ceiling of $250 for our survey of this category.

Prosumer cameras. Truly a term only a marketing manager could love, the prosumer-level camera offers high resolution and features that challenge even the professional digital cameras. Additionally, the quality of the lenses is vastly improved over entry-level cameras. Unfortunately, the prices these cameras fetch reflect this improvement. The prices in our survey for this grade of camera range from $799 to $2,000.

Professional cameras. Ahh, professional equipment. Nothing like having the right tool for the job. If you ask most photographers, they'll say that they'd love to have professional gear. The notion that good cameras make average photographers into experts is mostly false, but it's a hard one to disabuse because there is at least *some* merit to the idea, as a poor camera or lens can hamstring an imaginative photographer. Our solution? Show them the price tag. Professional-grade digital cameras are extremely expensive, ranging in price from $5,000 to $7,000 for the camera body alone. Add in lenses and flash attachments and watch the price jump to near $10K.

■ **Entry-Level Cameras.** If you're looking for a place to start, this is it. We've picked our favorite entry-level cameras, all of which sport USB (Universal Serial Bus) connectivity, glass lenses, and a bevy of features. Note that we didn't say these are the least expensive digitals out there; you can pick up a semidecent digital camera for less than $100 but, frankly, we don't recommend it.

Canon PowerShot A10. Featuring an effective resolution of 1.25 megapixels, the A10 is typical of most of the entry-level cameras we evaluated. The glass lens incorporates a 3x optical zoom and the camera also offers a 2x digital zoom. As storage media, the camera uses CompactFlash I. One surprising feature is the fast shutter speed of the A10. With a top shutter speed of 1/1,500 of a second, the A10 will do a reasonable job of capturing high-speed subjects. In line with its target market, the A10 is almost fully automated. Both focus and exposure are automatic, letting you concentrate on image composition instead of mechanics. One feature that may be important is the inclusion of an optical viewfinder. Many digital cameras rely entirely upon the LCD (liquid-crystal display) as a viewfinder. This can be cumbersome if you're more comfortable with traditional viewfinders. We found the Canon's controls to be intuitive,

Hewlett-Packard's PhotoSmart 318 is a typical entry-level digital camera.

though Spartan. The A10 uses AA batteries, but we recommend purchasing NiMH (nickel-metal hydride) batteries instead of alkalines; alkaline batteries simply won't provide enough power, except for short photo sessions. Originally released at $499, you should now be able to find the A10 for less than $200.

Sony DSC-P31. Sony's standard-bearer in this category is the $219 DSC-P31. With an effective resolution of 2 megapixels, Sony is trying to elevate the standard in point-and-shoot digital cameras. One disappointment is Sony's decision to rely solely on a digital zoom. Digital zoom lenses don't offer the sharpness and clarity of optical zooms, as they simply enlarge the image after it's been captured by the camera's sensor array. The storage media is Sony's proprietary Memory Stick, which is much smaller in size and capacity than CompactFlash devices. However, with Memory Stick capacities now reaching 128MB, this isn't a serious drawback. The DSC-P31 does let you record movie clips in MPEG4 (Moving Picture Experts Group) format and output images and clips to your television through an included video cable. The fit and finish on the Sony is of the high quality that has always been a trademark of Sony consumer devices, and as an additional value, the package includes NiMH batteries and a charger as a standard item.

Fuji FinePix A101. The A101 is a simple, Spartan camera that is perfect for anyone who just wants to take quick snapshots, record short video clips, or use the camera as a Web cam. With a 2x digital zoom, and a 1.3 megapixel resolution, the A101 follows the KISS principle: Keep It Simple, Stupid. Auto-focus, auto-exposure, and a simple integral flash make this camera perfect for someone who needs a camera but doesn't want to spend a week reading a manual. An automatic cover protects your lens when you shut off the camera, preventing you from damaging the lens. The A101 uses the ultra-compact SmartMedia cards for storing your images and relies upon AA batteries. Once again, it's a good idea to splurge for NiMH batteries instead of the regular alkalines. We found the A101 available for less than $150.

Hewlett-Packard PhotoSmart 318. The 318 sports a 2.3-megapixel resolution in a camera body that makes good use of ergonomic design to keep your hands and fingers away from the lens and flash. Interestingly, the 318 has 8MB of internal storage, as well as a slot for CompactFlash cards. Surprisingly, the lens is very simple, offering no optical and only a 2X digital zoom. The 318 utilizes four AA size batteries. An additional attraction of this utilitarian camera is its price. We found the 318 available for less than $200; for a 2-megapixel camera, this is a highly competitive price.

Olympus Brio D100. If you expected Olympus to break the pattern in entry-level cameras, you're going to be disappointed. Although the Brio D100 is a compact, easy-to-use snapshot camera, it doesn't have any features that make it stand out from the rest of the pack. The CCD (charge-coupled device) has a 1.3-megapixel resolution and supports output to NTSC video. Like the FinePix A101, the D100 uses the SmartMedia card, a medium that is quickly becoming the de facto standard for non-Sony ultra-compact digital cameras. Like Sony, Olympus bundles lithium batteries with the camera and even includes an 8MB SmartMedia card. The D100 can also use NiMH batteries, as well as alkaline. The D100 doesn't offer an optical zoom, but instead provides an inferior 2x digital zoom. You should be able to find the D100 for about $180.

Sony's Cybershot DSC-P31 is our Editor's Pick for entry-level digital cameras.

Editor's Pick Entry-Level Camera

The clear winner in this category was the Sony DSC-P31. Even though the Sony was the most expensive of the entry-level cameras we looked at, it was also the most feature-rich. The combination of high resolution with advanced exposure and metering propelled this camera to the top of our list of entry-level units.

Nikon's Coolpix 5000 is a solid performer, featuring 5-megapixel resolution.

Prosumer Cameras. It's only one step up, but what a step. The prosumer cameras are more sophisticated, more complicated, and more (often much more) expensive. Here are our favorites.

Nikon Coolpix 5000. The 3x Nikkor lens provided with the Coolpix 5000 is typical of the prosumer camera market. Boasting excellent optics, these lenses are vitally important in capturing sharp, accurate images. The resolution of the 5000 is 5 megapixels, more than enough for all but professional quality images. The 5000 also implements a large swiveling LCD that can be useful in confined quarters where using the traditional viewfinder would be impractical. Unlike entry-level cameras, the 5000 offers a hot-shoe mounting point for external flashes in cases where the built-in flash is inadequate. Another difference between the 5000 and entry-level cameras is the former's ability to manually control most aspects of exposure and white balance. For storage, the 5000 supports CompactFlash types I and II, as well as IBM Microdrives up to 1GB. With 5-megapixel resolution, a 1GB storage card or drive lets you store the highest quality images without worrying about space restrictions. Another great feature is the ability to capture QuickTime video with an audio track. However, these features don't come cheaply; the 5000 retails for $1,099.

Canon G2. When examining the G2, it would be easy to jump to the conclusion that the Canon engineers took the PowerShot A10 and pumped it full of steroids. Boasting a 4 megapixel resolution, the G2 gives the user the option of relying on automatic features for exposure and focus, or taking the reins and managing all the details manually. Canon includes a remote control for specialty shots, and you can use a lens adapter in conjunction with wide-angle, telephoto, or

Be prepared to cash in your retirement fund if you plan on buying a professional-grade digicam. This Nikon D1X lists for more than $6,000.

close-up lenses. Like the Coolpix 5000, the G2 features an articulated LCD that provides a clear, bright view of your subject. If you need an external flash for low-light shooting, the G2 provides a hot-shoe mount for Canon Speedlite flashes. Video recording with audio is supported on the G2, and with either CompactFlash or Microdrives for storage, you can use your G2 as a surrogate video camera. (It won't be able to record for as long as a traditional camcorder, but for spontaneous events the ability to capture video may be attractive.) The G2 uses USB for direct transfers to your personal computer, video out to NTSC or PAL monitors, and direct connection to Canon Card Printers such as the CP-10. The current retail price for the G2 is $799, making it an excellent value.

Sony DSC-F707. The F707 is yet another example of Sony following its own path in camera design. The ergonomics of digital cameras has always been problematic, as they've become smaller and smaller. Yet the F707 successfully balances size with usability. It doesn't hurt that the massive Carl Zeiss lens provides a convenient hold point for your left hand. And at almost 5 inches in length, "massive" is not an exaggeration. Boasting a 38-190mm range (35mm equivalency), this lens is sharp and bright. Curiously, the F707 doesn't rely upon an optical viewfinder, but instead uses an LCD viewed through an eyepiece to mimic a conventional optical viewfinder. This is far more intuitive than merely relying on the back-panel LCD, as most photographers are accustomed to having their eyes close to the camera when they're composing a shot. The F707 offers a maximum resolution of 5 megapixels, and can record to JPEG, GIF, or TIFF formats. Like all Sony digital cameras, the F707 uses the Memory Stick for storage. With the Memory Stick currently limited to 128MB, the high resolutions of the F707 may tax this capacity in short order. Recording video and audio are also supported. The F707 retails for $999.

Sony MVC-CD400. The top of Sony's Mavica CD line, the CD400 is a natural evolution in Sony's development of digital cameras with recordable CD storage. With 4-megapixel resolution and the ability to use CD-R (CD-recordable) and CD-RW (CD-rewriteable) storage, the Mavica CD line is one of the most cost-effective cameras on the market. The drawback is that battery life is shorter than that of cameras that use CompactFlash or other solid-state media for storage. However, one benefit of the camera's CD-based storage is the ability to transfer files to your computer by simply inserting the 3-inch CD into your computer's CD-ROM drive. Like the Sony F707, the CD400 can record in JPEG, GIF, or TIFF format, as well as video in MPEG format with audio. The camera's biggest flaw is the lack of a true viewfinder; many photographers will find usirfg the rear-mounted LCD uncomfortable. Although the Carl Zeiss lens isn't as powerful as the one provided on the F707, it is still a high-quality lens with a true 3x zoom. Retail for the MVC-CD400 is $899.

Editor's Pick

Among the prosumer cameras, the sophisticated Canon Powershot G2 takes our Editor's Pick honors for its robust feature set, excellent optics, and relatively affordable price.

Nikon D100. Including the D100 in this category doesn't appear fair to the other entries, but the D100 clearly belongs in the prosumer camp. All the compromises the other models have made are ignored entirely by the D100 and similar high-end prosumer cameras. Instead, the compromise is in the cost. At the time of this article, the suggested retail price for the D100 hadn't been set, but the street price should be about $1,999. For two grand, you get a camera that can use most of Nikon's excellent Nikkor lenses. For image capture, the D100 uses a 6-megapixel CCD sensor and excellent batteries that let you to concentrate on your subject, not your power supply. For storage, Nikon uses CompactFlash I and II as well as IBM Microdrives, and with hi-res file sizes up to 18MB, you'll want to be sure you have plenty of space for long photo sessions. Perhaps the only black mark on this camera is the use of USB instead of IEEE 1394 (FireWire) for file transfer. With larger file sizes, the extra speed of a FireWire connection would have been greatly appreciated. If you want professional features without paying through the nose, the D100 just might be your best choice.

Editor's Pick
Prosumer Camera

In our three categories, this proved to be the hardest decision. If Nikon's D100 had even a slightly lower price tag, it would have been a shoo-in. However, the best overall value is Canon's PowerShot G2. Although not as competitive in resolution as some of the other prosumer cameras, the G2 is an outstanding value with exceptional lenses, solid power management, and good ergonomics.

Professional Cameras. If you're a professional photographer or an exceptionally well-heeled amateur (or if you just want to drool over the best of the best), you'll be interested in checking out our three top picks. Elegant, sophisticated, and feature-laden, these are the pick of the litter. Watch out for sticker shock, though.

Canon EOS-1D. The 1D is a marvelous camera to use. From its magnesium body to its solid heft and feel, the 1D is aimed squarely at the professional photographer who needs the ultimate in flexibility, speed, and performance. One facet that may surprise you is the (seemingly low) resolution of the 1D. Although a resolution of 4 megapixels isn't anything to sneeze at, on

The unique style of the F707 encourages you to hold the camera in a rock-solid position.

Although Sony's CD Mavica line offers affordable and convenient storage, the lack of a traditional viewfinder is irritating.

the surface it would appear to be lower than most professionals would require. The trick is that the quality of the CCD is just as important as the number of pixels, and here the 1D elevates itself above the prosumer level cameras. The sensor is larger than the average prosumer CCD and renders extremely accurate colors. Combine an 8fps (frames per second) shutter rate and an extremely fast auto-focusing system, and the 1D makes the job of a sports photojournalist a snap. As is typical of this market segment, the 1D uses Canon's EF series of lenses and gives the photographer a great deal of flexibility in choosing how much control to exert. The 1D uses CompactFlash for storage and the speedy FireWire interface for transferring images to your personal computer. The only downside to the 1D is the price tag. The EOS-1D retails for $5,500, without lenses, and a good lens and flash can set you back another $3,000.

Nikon **D1X.** Nikon's D1X is a good counterpoint to Canon's EOS-1D. But with a 5.3-megapixel sensor, the D1X may be a better fit for commercial photographers who need the extra detail in large images. The CCD on the D1X does an exceptional job of reducing digital artifacts (errors in signal processing, also referred to as "noise") in long exposures. And if you already own a set of Nikkor lenses, you'll be happy to know that they can be used with the D1X. The storage medium of choice is CompactFlash, but the camera also supports IBM Microdrives. You can save your images in either JPEG or TIFF format, or as raw uncompressed images. Like the Canon EOS-1D, the Nikon is a heavy camera, weighing in at 2.5 pounds without batteries or lenses. The D1X's frame rate isn't as fast as the Canon's, but 3fps does allow you to capture most spontaneous moments and sports with ease. One feature that separates the D1X from prosumer cameras is this unit's attention to durability. The D1X has an extensive series of rubber and plastic seals and O-rings to keep the electronic components free of dust and grime. It also has more cushioning to absorb the abuse that often comes from being used by professionals in the field. Retail price for the D1X is $5,400 for the body, and lenses can range from $500 to $5,000.

As camera prices continue to tumble, the $2,000 D100 may become more affordable.

Contax N Digital. Contax is renowned for producing high quality cameras at high prices, and the soon-to-be-released N Digital model continues this philosophy. The key features differentiating the N Digital from other cameras in this class are the combination of 6-megapixel resolution and a full-size sensor. Most digital camera sensors are smaller than the frame area of a 35mm negative. This affects photographers who shoot subjects from a distance, as their lenses benefit from a multiplier effect. A common multiplier might be 1.3, so a standard 50mm lens would have an optical power similar to a 65mm lens. The downside is that the opposite effect occurs with wide-angle lenses. Because this unit features a full-sized sensor, its lens sizes need no conversion to 35mm equivalents. And speaking of lenses, Contax uses the outstanding Carl Zeiss "T*" lenses for the N digital, but be prepared to pay a king's ransom for each lens. Like most of the cameras in this class, the N Digital uses CompactFlash I and II for storage, as well as high-speed FireWire connections for image transfers. The expected street price for the N Digital body is about $7,000, and lenses typically run into the thousands of dollars.

The Carl Zeiss "T" lenses used with Contax cameras are world-famous for their sharpness.

Editor's Pick Professional Camera

Choosing among these three cameras is akin to fighting over seats on a transatlantic flight on the Concorde. All three units function with a measure of style and performance that other digital cameras only dream of. However, because it is our job to choose, our choice would be the Canon EOS-1D because of its high shutter rate and excellent auto-focus system. Just be sure your bank account can withstand the stress of buying one of these super-cameras.

A Small Piece Of History. The urge to record our history, to capture where we've been, what we've seen, and what we've done, is an almost universal desire, as is the need to create and to interpret our surroundings. Since the beginnings of photography, these desires have propelled much of the technology, and digital cameras are the culmination of our need to create tangible reminders of our lives.

Although film cameras still hold a place in this market, it's clear that the future belongs to digital cameras. Luckily for camera buyers, the breadth and scope of digital cameras means that for each niche, specialty, and profession, there is a digital camera for you. LS

by Chris Jackson

Our Editor's Pick for professional camera went to Canon's EOS 1D. The unit is essentially perfect, assuming you can handle its stratospheric price tag.

Your Digital Camera Handbook

A Digital Photography Primer

As digital camera quality improves and prices drop, casual photographers and serious hobbyists alike are turning away from film and toward digital for their day-to-day photography needs. This isn't to say that film cameras are obsolete. Film still brings a level of image quality that consumer-level digital cameras can't quite match (although they are getting pretty close).

But with digital cameras, photographers can take all the shots they want and not worry about film or development costs. This means that even casual photographers are taking more pictures, doing more experimenting, and spending more time with their cameras. Thanks to digital cameras, a new generation of photography enthusiasts has been born.

To help this new generation get started, we offer you a primer on shooting digital. We begin by exploring the basic elements that affect an image and then discuss how to use your camera settings to control those elements in various picture-taking situations. Finally, we'll focus on specific strategies for photographing people, landscapes, and action.

■ **The Elements Of An Image.** To use a digital camera and capture a scene the way your eyes see it, you need to understand the elements that affect your image and then learn how to use your digital camera controls to adjust those elements. Let's start with an overview of those elements.

Light. Other than your subject, light is the most important element of your scene. It illuminates the subject, making it light or dark, and creates highlights and shadows that give your subject texture and depth. The amount of light that reflects off of your subject and onto the sensor array inside your digital camera determines the image's exposure (its overall lightness and darkness, and the range of the two).

To our eyes, the light from different sources, such as the sun, a light bulb, florescent lights, or a candle, looks white. In fact, the "white" light actually consists of a mixture of all the colors of the spectrum in different proportions. For example, light from the sun contains more blue than light from a candle, which contains more red. We sometimes say that daylight has a "cool" color, while incandescent light bulbs and candles are "warmer." These different light sources give your subject a different color cast. In most cases, you prefer not to have a color cast, so digital cameras include **white balance** controls to eliminate either type of cast.

Direction of the light. How your light falls on your subject is extremely important, since it affects how shadows fall in the picture and the amount of surface detail you can see.

Typical photographic scenes have one of four types of lighting: **back lighting**, which darkens your subject, reducing the detail and giving a silhouette effect; **side lighting**, which casts pleasant shadows that emphasize the surface details of your subject; **front lighting** in which shadows and surface details are reduced and the subject has a washed-out appearance; or **top lighting**, which casts long shadows, especially around a subject's eyes and beneath the nose.

Quality of the light. Light is either **direct**, illuminating your subject from one direction and creating more contrast between light and dark areas, or **diffuse**, bounced onto a subject from many different directions creating a softer, lower contrast image.

Depth of field. At any given time, as you focus on the subject of a picture, there is an area in front of your subject and behind your subject that is in focus, or nearly in focus, with areas outside of that range being out of focus. The range that is in focus is called **depth of field.**

Subject motion. Subject movement tends to blur the image, lowering sharpness. In some picture situations, this blurring effect can add a desirable sense of motion. However, with most pictures, the goal is to freeze the subject and reduce any blur to a minimum.

■ **Control Light, Depth of Field & Motion.** To get the best image, you must use components of your digital camera to control light, depth of field, and motion.

Aperture. This iris-like opening in the camera lens is widened to let more light hit the sensor array or narrowed to less light in. The term **f-stop** is used to describe the size of the aperture opening and commonly ranges from f/1.4 (a wide opening) to f/16 (a narrow opening), with typical "stops" in between of f/2, f/2.8, f/4, f/5.6, f/8, and f/11. To lighten a picture, the photographer opens the aperture by using a lower f-stop (which lets more light in), and to darken an image you close the aperture by using higher f-stops (which let less light in).

Aperture also plays a role in depth of field. Setting the f-stop to f/2 or f/4 (opening the aperture) reduces the depth of field. Going to a

Depth of field determines the range of focus for an image. The background and foreground are blurred with a narrow depth of field (top image) but visible with a wide depth of field (bottom image).

higher f-stop, such as f/11 or f/16, increases the depth of field. Note that in digital cameras, the effect that aperture has on depth of field is not as pronounced as it is in film cameras.

Shutter. The shutter is a cover over the sensor array that opens for a fraction of a second when the shutter release is pressed. In that brief instant, light coming through the aperture falls on the sensor array making the exposure. (Many digital cameras achieve the same results not by using a mechanical shutter but by momentarily resetting the sensor array.) Shutter speed is a measure of how long the shutter is open and, depending upon your camera, can be set from 1/2,000 of a second to 4 seconds or longer. Lower shutter speeds mean that more light falls on your sensor array and the image is thus lighter. Higher shutter speeds mean that less light falls on the array and the image is correspondingly darker.

Shutter speed also plays a roll in freezing subject movement. In action photos, higher shutter speeds, such as 1/500 or 1/1,000, freeze the motion of the subject, making the moving subject sharp and detailed.

Lens focal length. The focal length of a lens is the distance between the optical center of the lens and the film or the sensor array. Basically, it determines the angle of view for the lens (wide-angle, normal, or telephoto).

A zoom lens has a variable focal length and is like having multiple lenses. Many digital cameras have zoom lenses and in fact refer to having both optical zoom and digital zoom. **Optical zoom** is a true zoom, involving physical movement of the lens; it's always preferable to **digital zoom**, which is really just a magnification of the image sensor array. The digital zoom typically gives your images a jagged-edge look.

Depth of field is affected by the focal length. Wide-angle lenses increase depth of field, and telephoto lenses decrease it. In a similar way, the distance to the subject changes the depth of field. Moving closer decreases depth of field and getting farther away increases it.

Summarizing what to do. Here's a brief summary of the most important image elements and the camera components that control them.

- To lighten an image, use a larger aperture (lower f-stop).
- To darken an image, use a smaller aperture (higher f-stop).
- To stop motion, use a higher shutter speed, move back from the subject, or use a wide-angle lens.
- To increase depth of field, use a smaller aperture, move back from the subject, or use a wide-angle lens.
- To decrease depth of field, use a larger aperture, move closer to the subject, or use a telephoto or zoom lens.

The Exposure, White Balance & Flash Controls On Your Camera.

Your digital camera has an automatic exposure system in which an internal light meter determines the proper aperture and shutter speed for the correct exposure. The system also includes color sensors that set the proper white balance and turn the flash off and on. We'll go over some of the typical camera modes below. Remember that the terms your camera uses to describe these modes may vary slightly from one camera to another and from the terms we use here.

Exposure modes. Most digital cameras have more than one exposure mode, letting you override the automatic system and make choices about exposure, depth of field, and motion. Less expensive digital cameras usually offer automatic mode, programmed mode, and exposure compensation.

Traditionally called the "point and shoot" mode, the **fully automatic mode** sets the aperture, shutter speed, and white balance without any intervention from you. In a case like this, the camera is making all of your decisions for you.

Programmed mode lets you select from a menu of common scenes, such as portrait, landscape, or action, and the camera sets the

Exposure compensation lets you overexpose or underexpose an image. Here, a snow scene has "tricked" the automatic exposure and the image is too dark (top image). Using an exposure compensation of +1EV brightens the image.

best aperture/shutter speed combination in regard to exposure, depth of field, and motion. For cameras that don't have manual settings, this mode is the next best thing.

If you'd like to purposely overexpose or underexpose an image, the **exposure compensation mode** lets you override what your camera's light meter suggests. Usually you have a menu with settings expressed as EVs (exposure values) that range from –2 (underexpose) to +2 (overexpose).

More sophisticated cameras also include aperture priority, shutter priority, and manual modes, all of which give you even more control over your exposure.

With **aperture priority mode**, you select the aperture and the camera then selects the best shutter speed for the aperture you've chosen. This mode is perfect when depth of field is important, since the aperture is the primary way one adjusts depth of field.

Shutter priority mode lets you select the shutter speed, while the camera sets the best aperture for that shutter speed. This mode is handy when your major concern is to freeze (or purposely blur) action and you need a high (or low) shutter speed.

The best digital cameras also include a **manual mode**, which lets you set both the aperture and shutter speed. The camera's metering system indicates what the proper settings should be, but you can override that setting. This mode is not as easy to use as the aperture priority or shutter priority modes, but it allows the photographer complete control. (And it's especially useful for **bracketing**, a technique in which the photographer shoots at the exposure recommended by the camera and then also shoots one or two purposely over- and underexposed shots, to ensure that at least one of the images will be exactly what she had in mind.)

Flash modes. To help in low-light situations, a digital camera typically has a built-in flash that automatically fires when there's not enough light. As with the exposure, there are different flash modes that your camera might have, including **automatic**, where the flash fires when needed; **full-time**, where the flash is always on; **red-eye reduction**, where a preflash helps reduce the anomaly called red-eye; **fill flash**, which is used to lighten shadows in an otherwise well-lit scene; and **flash cancel** which turns the flash off.

White Balance Controls. Digital cameras have built-in white balance circuitry that automatically adjusts the color sensitivity of the sensor array to the type of light in the scene. The automatic controls work well in most situations, but some cameras include additional white balance controls, including a **daylight** setting for shots in bright sunlight, a **cloudy** setting for overcast days, **tungsten** (incandescent) for shooting under regular light bulbs, and **fluorescent** for images taken beneath fluorescent lights.

Using the rule of thirds, you divide the viewfinder into horizontal and vertical thirds, creating nine zones. Placing the subject of your image along the edge line of the center zone creates a more balanced, pleasing image.

Lighting early or late in the day produces a soft, diffuse look with fewer, softer shadows. Notice that in this image we also use the yellow bars to frame the subject.

■ **General Considerations.** Now let's look at how you can use your digital camera controls to take charge in some common picture-taking situations. We'll start with some advice that covers general picture taking. Remember, there's no such thing as hard and fast rules in photography, but there are some guidelines you might want to keep in mind.

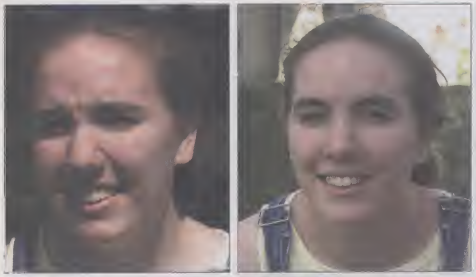
The rule of thirds. As you look through the viewfinder, mentally divide the scene into horizontal and vertical thirds, creating a grid of nine zones. Instead of placing your primary subject in the center zone, right in the center of the viewfinder (which is what amateurs tend to do), place it along the *edge* of the center zone, on top of one of the third lines, or at one of the corners of the center zone. This tends to offset the subject and make your picture more interesting.

Fill the frame. Don't leave lots of empty space around your subject. Either move the camera closer, or use your zoom lens. You can also get a pleasing effect by "framing" your subject with foreground objects such as tree branches or a doorway. And don't forget to turn your camera and try the shot both horizontally and vertically.

Use Programmed Exposure Mode. If your camera has this mode, and no other manual exposure modes, get used to using it. Programmed Exposure Mode is normally more precise in setting exposure than plain automatic mode is.

Bracket and use your LCD (liquid-crystal display). The great thing about shooting digital is not worrying about film and development costs. This means that on your important shots, you should use the exposure compensation controls and take multiple exposures. This process is commonly called bracketing. You can also use your camera's LCD to preview different exposures and focal lengths. This is one of the great benefits of shooting digitally, so take advantage of it by shooting lots of pictures and by using the LCD to preview the image you just shot.

Expose for the highlights. Digital cameras have trouble with images containing both very white and very dark areas. If you have to choose between which area to properly expose, choose the highlights. You can



Top lighting produced by the sun at mid-day creates harsh shadows in the eyes and beneath the nose (left image). The same shot taken in the shade shows the advantages of diffuse light (right image).

do this by using exposure compensation and overexposing by +1EV. Your image-editing software can usually do a much better job of recovering detail from shadow areas than from light areas.

■ **People & Portraits.** Photographing people requires careful thought if you want to get the best possible image. And though you won't treat every shot as if it were a formal portrait, just about every guideline we mention here applies to both informal and formal people pictures.

Outdoor lighting. Outdoors, natural lighting is always preferable to flash when taking people pictures. Try to avoid midday shots where the overhead sun creates long shadows in a subject's eye sockets and beneath his nose. Shooting early or late in the day, or on cloudy days, produces warm, diffuse lighting that is more pleasing. And rather than having the sun directly behind you, position the subject for side lighting, which creates pleasing shadows and good surface detail.

If you must shoot with the sun overhead, try underexposing the shot by –1EV or –2EV to reduce and soften the harsh shadows. Better yet, find a shady spot where the light will be more diffuse. If you find the shady spot too dark, use your camera's fill flash to brighten the subject's face.

Indoor lighting. If possible, avoid using your flash indoors, because it flattens details and washes out your subject. If you must use it, move your subject away from background walls where dark shadows cast by your subject will appear. Also, try diffusing the light from your flash by covering it with a white tissue or thin cloth. If you can tilt your flash, point it upward and bounce it off the ceiling to create more diffuse light.

With flash, you also get red-eye, a situation in which light enters the subject's pupil and reflects off of blood vessels on the back of the eye. You can reduce red-eye by using your camera's red-eye reduction feature, using an off-camera flash unit, or having the subject avoid looking directly at the camera.

To shoot indoors during the day, position your subject near window light, especially windows facing north or south that have less direct (and therefore harsher) light. Your goal is to use side lighting, so don't put the window directly behind you or directly behind the subject. You can add some additional reflected fill light by placing white cardboard on the floor to reflect the light from the window upward. This will fill and add highlights to the underside of the subject's face and chin. (A piece of aluminum foil crumpled into a ball and then uncrumpled, flattened, and taped to a piece of cardboard also makes a good reflector.)

For subjects in front of a bright light source, such as a window (or a sunset), use your camera's exposure compensation controls and overexpose by +1EV or +2EV. If you want the subject silhouetted, underexpose the image by –1EV or –2EV.

Although you can purchase expensive photo lamps covered with diffusion material, try using regular household lamps to illuminate your subject. With your digital camera's white balance controls, you can experiment with different color casts. Also, try diffusing the lamp's light by bouncing it off of white cardboard or the ceiling, or place white tissue or a white cloth between the light and the subject to soften the light.

Depth of field. Setting a narrow depth of field reduces background clutter in people pictures. If your digital camera has aperture priority mode, set it to a low (that is, a larger opening) f-stop. If not, zoom in and move your subject away from background objects. In portrait situations, you can control the background by using a throw cloth or neutral wall as your background. Keep the background at least 3 or 4 feet behind the subject, so that the short depth of field will throw the background itself out of focus.

Focal length. The best portraits come from zooming in on the subject. First, zooming narrows the depth of field to remove background clutter. Second, telephoto lenses "compress" the features of people, providing a much more

Flash images tend to flatten details and produce dark shadows behind subjects (right image). Light from a window produces diffuse light that softens the image and reduces harsh shadows (left image).

pleasing appearance; wide-angle shots tend to emphasize such features as noses and ears, telephoto shots tend to minimize them.

Landscapes & Buildings. There's nothing quite as satisfying as capturing the beauty of sunset or the grace of a towering mountain. But as with people photography, there are some things you can try to make your shots even better.

Lighting. The best lighting comes early and late in the day, when the light is more diffuse and the shadows are less harsh. This is also the time of day when the sky is most colorful. To see how shadows and highlights vary, always bracket your landscape shots, especially sunsets and scenes with white clouds against a blue sky. And for sunsets, don't forget to turn around and shoot objects behind you that are being illuminated by the warm, colorful light.

When shooting bright scenes that can fool your automatic exposure settings, such as snow-covered landscapes or sunlit beaches, use your exposure compensation controls to overexpose the image by +1EV.

For flowing water, mount your camera on a tripod and use your digital camera's shutter preferred mode to set longer shutter speeds. This blurs the water and gives the effect of a flowing stream.

Depth of field. Landscapes tend to benefit from a long depth of field. Although depth of field with digital cameras tends to be fairly wide at most aperture settings, it's still a good idea to use aperture preferred mode and close the aperture down. For automatic-only cameras, zoom out to increase the depth of field.

Also consider that when shooting a subject that extends into the distance, most photographers adjust the digital camera focus on the distant part of the scene ("infinity"), which gives you a depth of field from about 50 feet to as far as you can see. To get better depth of field, focus on a closer part of the subject. This brings the depth of field closer to you and puts a larger part of the scene in focus.

You'll usually also want a wide depth of field for buildings. And don't forget that adding people to the front of a building shot gives the viewer a better sense of perspective.

Shooting straight up from the base of a building often distorts its height and gives the illusion of **keystoning**, where the edges of the building seem to converge in the distance. In this case, try moving away from the building or shooting it from a higher elevation.

Focal length. Wide-angle shots provide a broad, sweeping perspective of landscapes, buildings, and building interiors. But zooming to telephoto gives the interesting effect of "compressing" distant objects so that they appear together. For example, zooming in on an old farmhouse with mountains in the background makes the house appear to be at the foot of the mountains. Or zooming in on a street scene compresses cars and building fronts, making them appear much closer than they are. Zooming in on sunsets makes the sun appear much larger in relation to objects in the foreground.

The sky is most colorful late (or very early) in the day. By using your camera's compensation controls and underexposing, you can silhouette foreground objects and deepen sky colors.

Sports & Action. Sports and action shots are a special challenge to digital cameras, because there is often a delay between pressing the shutter and when the image is actually taken. For this reason, you must anticipate your pictures. If your camera has one, it helps to use its **burst mode**, where it quickly takes three or four pictures automatically.

Zooming in with a telephoto on landscape scenes tends to compress the image and make objects appear closer than they are. Here the windmill and base of the mountain are brought together.

Light and motion. With most action shots, the goal is to freeze the motion. On digital cameras that have it, use Shutter Preferred mode to set a fast shutter speed. With automatic cameras, try positioning the camera so that the action is coming toward you. This "slows" the object's relative speed and causes less blur. You can also pan your camera with the action. This again slows the object's relative speed but blurs the background, giving a sense of motion. And if your subject is close enough (generally within 15 feet), use your flash to stop the motion.

Focal length and motion. Wide-angle shots of subjects in motion tend to show less blurring than telephoto shots. You also get a wider depth of field, which helps offset situations where a fast shutter speed with a wide aperture is creating a narrow depth of field.

If your action shot is well lit, you can use your zoom lens to isolate and freeze subjects. As you do this, if your digital camera has auto-focus with no manual override, you can keep the moving subject in focus by continuously pressing the shutter release button to pre-focus as you track your subject in the viewfinder.

Once You Get Things Together. Mastery of your digital camera doesn't happen overnight. It only comes with lots of picture taking, experimentation, and constant review of your images. But as you progress, interpreting scenes will become second nature, and the feel of your digital camera's controls will be as comfortable as an old pair of shoes. LS

by John Lortz and Susan Leavitt

room to burn

VINYL
DIGITAL VIDEO
DATA BACKUP
ORIGINAL MUSIC
DIGITAL PHOTO
MP3

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Wedding Bell Views

Use Your Digital Camera To Shoot A Wedding

So you finally caved in and bought that shiny new digital camera. After it arrives, you quickly charge up the batteries, pop in a memory card, and start looking around for your first victim . . . er, subject. At first you prowl your usual haunts, capturing all the obvious subjects: the dog, the kids, your friends at work, your house, more kids, more dog. But before long, you tire of the mundane and yearn for an assignment with, well, more meat. After all, there are only so many pictures you can take of the kiddies. Sure, they're cute, but it's not exactly a challenging assignment.

With some luck, it's at this critical point in your photographic development that you'll be invited to a wedding. Perfect. Memories in the making, and all the chance you could hope for to demonstrate your photo-technical prowess. Not only can you take more pictures than anyone else (after all, *your* camera is digital), but you can also burn them to a CD-ROM and present the disc as a gift to the bride and groom. As your excitement grows, however, you realize that there's a minor problem with this plan: You don't have a clue how to shoot a wedding. And professionals spend a lifetime learning this craft. Not to worry, however—that's why we're here. If you follow the tips in this article (compiled with the help of 20-year wedding photography veterans Paul and Darlene Miller; http://www.millerpix.com), you can be assured of good photos.

Be Prepared. Before you start shooting the perfect wedding, there are a few things you'll need. First, follow the lead of professional photographers and bring two of almost everything. This may seem like overkill, but horror stories abound of missed shots and irate brides, all because the photographer dropped the camera or the battery went dead at the worst possible moment. If you're serious about this, make sure to cover your bases.

Bring two of everything. For the amateur, covering your bases generally means bringing two of everything except the camera. And if you happen to have two cameras, bring them both. If you're like most of us and have only one, make sure you put a neck or wrist strap on the camera and use it faithfully. Nothing will dampen your plans more than watching your new techno-prize crash to the floor while you're jostling for a good photo position. Don't think that it can't happen to you. Many a professional photographer has thought that, often with disastrous consequences.

Bring along at least two sets of batteries. Digital cameras chew through batteries like politicians snapping up a budget surplus; one fully charged battery may only get you through part of the wedding. This is especially true if you're counting on your camera's flash to provide most of the lighting, so think ahead to the time and place where the wedding will be held and prepare accordingly. Is the wedding to be held outside in the middle of the day? Two sets of batteries will probably do it. Is it a candlelight service late in the day in November? Better bring a few more.

You should also bring at least two memory cards. One of the major advantages of using a digital camera is the ability to shoot endlessly with no additional film costs, but you can't do that if your memory card fills up prematurely. And because you'll be taking high-resolution photographs, make sure you get 128MB cards. At the highest resolution on our 3.34-megapixel camera, a 128MB CF (CompactFlash) card will only hold 12 photographs. If you can't afford to purchase another CF card (or Memory Stick, for those of you with Sony cameras), we suggest stepping down one notch in resolution or storing your photos in the highest-quality JPEG (Joint Photographic Experts Group) format possible, rather than using high-resolution TIFF (Tagged Image File Format) files. To the human eye there isn't much difference between these formats, but you'll triple or quadruple your available storage space.

Don't forget about the extra goodies. Depending on how enthusiastic (and well-heeled) you are, you may want to bring along wide-angle and telephoto lenses. These optional items will add significant flexibility to your photo choices. With a telephoto lens, you can capture the first kiss from the back of the church, rather than trying to sneak down the middle of the aisle during the service (a definite no-no). A wide-angle lens will help you capture the entire wedding party without forcing your back against the opposite wall and give nice full shots of the church and reception hall. Wide-angle lenses do distort a bit, so be careful when using them with people.

Finally, make sure you don't forget miscellaneous items such as lens cleaner and tissue, a tripod, an 18% gray card, and a good camera case. With all of this assembled, you should be well prepared for a good shoot.

Twenty-year wedding photography veterans Paul and Darlene Miller shared their insights and secrets with us.

Have A Plan. Before you plan for your wedding shoot, it is important to identify your proper position within the proceedings. For most of us, our position would be "invited guest and amateur photographer." If you're brave enough to accept an invitation to be the *official* photographer (definitely not recommended, at least not until you've shot many, many weddings as a guest), you'll have complete control of the proceedings. You may pose people as you like and generally order everyone about. If not, you'll have to work within the confines of what the professional is doing. Whatever you do, remember that the ceremony itself is more important than the pictures; the photos are supposed to memorialize the ceremony, not interfere with it. With that in mind, it's always a good idea to know what you'd like to shoot ahead of time.

Use an outline or checklist. No pro shoots a wedding without a detailed outline of what, when, where, and how she's going to shoot. Professionals with hundreds of weddings to their credit know the routine by heart, but as an amateur, you'll probably want to write it down on a checklist. Most of the time, these shots are standard, falling neatly into four distinct categories: before the ceremony, during the ceremony, before the reception, and during the reception. You should plan accordingly, knowing what shots you'll want to take and when. To help you with this, we've included a list of the most popular wedding shots that you can use to plan your particular event. (See the "A Wedding Photo Checklist" sidebar.)

Once you've selected the shots you want to take, you should also give some thought to things such as lighting, orientation (landscape vs. portrait), and backgrounds. During the ceremony, for example, you should set your tripod up at a strategic location so you can shoot the first kiss without using a flash. If you try this while holding the camera, you probably won't get the shot: a slow shutter speed in a low-light situation with a handheld camera will result in a blur, while a flash probably wouldn't reach more than 15 to 20 feet. (Also, a flash shot during the ceremony would be intrusive.) If you do plan to use a flash, take some test shots before the wedding so you know the range of your particular flash and make sure you stay within it.

With a list like this, you'll greatly increase your chances of producing high quality photographs, rather than a series of snapshots. Now if you could just get people to pose naturally, you'd be set.

Avoid Three Common Mistakes. Now that you have a list of the shots you'll want to take, you should give some consideration to the various poses. Our pros tell us that nearly any pose will work if you avoid some very common mistakes.

Deer in the headlights. This is the most common mistake people make. The camera angle is straight on at shoulder height. The subjects are lined up shoulder-to-shoulder, hands folded in front, and told to "say cheese." The result is a picture that appears stilted and unnatural, not the sort of thing you want to remember years later. People feel uncomfortable and the picture reflects it. To steer clear of this problem, avoid straight lines and straight-on shots. For example, pose the wedding party in a "V" shape up and down a set of stairs rather than standing shoulder-to-shoulder. Rather than facing forward, the subjects could look straight ahead while angling their bodies toward the centerline of the "V." If you're not sure whether a pose will work, you can increase your chances of capturing a good photo by taking the shot from several different positions. And because you have a digital camera, you can try several different angles for the same pose at no additional cost.

Get in close. Another common trap amateurs frequently fall into is standing too far from the subject. The Millers suggest you get in close. Not only will this make your flash more effective, but it will also fill more of your shot with the subject (rather than the background). You'll also get much better detail with a close-up shot than you will by trying to enlarge and crop a portion of a long-distance shot.

Watch your background. Always be mindful of what's behind your subject. Nothing says "amateur" more than a plant or a coat rack growing out of someone's head. (As an excellent example of what not do, notice how the candles in our photo of the Millers make Paul look like he has moose antlers.) If you aren't afraid to experiment, you can de-emphasize a poor background by setting your camera's f-stop (that is, opening the aperture) for a shallow focal range. This will cause anything in the background to go out of focus. If you're uncertain, just give it a try. Because you're shooting digital, you'll see immediately if you've achieved the desired effect.

If you avoid these three common errors, you should get some fairly good pictures. The Millers also recommend that you look at professional wedding photos to get a good idea of how to pose your subjects. If you're not comfortable telling people how to stand (or where to look), you may be able to take advantage of the professional's good nature; many professional photographers will pose their subjects and then step back to let guests take snapshots. This would be a perfect time to take advantage of the professional's posing knowledge and try some different things. If you do this, however, be careful not to interfere with the pro's work (more on this later). And whatever you do, don't expect perfection immediately; the pros work at this for years before they get it right.

Wedding Photo Etiquette. A wedding is arguably one of the most stressful ceremonies ever devised by humans: a nervous bride and groom, 200 whispering guests, and high expectations all around. What happens here will be rehashed for years to come, for better or for worse. The bride has spent months preparing for her day, and if anything goes wrong, you can bet that *somebody* is going to pay. It is within this context that we want to mention a few words about wedding etiquette, because if anything does go wrong, you'd better hope that it isn't your fault.

Just say "no" to flash. Every bride and groom yearn to hear those magical words, "You may now kiss the bride." What they don't want at that moment is a flash going off in their faces. In fact, good professional photographers never use flash during the actual ceremony, and they work hard to stay as much in the background as possible. You should do the same. If you want a picture of the ceremony, use a tripod and a slow exposure to capture the moment.

Stay out of the ceremony. Good photographers record events; they don't become a part of them. Jostling with other guests for a good position is definitely not good. Neither is kneeling

in the middle of the nave (the area running down the center of most churches that includes a main aisle) during the processional. Remember that you're not a news photographer and this isn't some catastrophic news event. (At least we hope it isn't.) As a general rule, you should always work from just outside the sphere of activity, with the exception of those times specifically set aside for photographs. If it isn't possible to get the shot you want without violating this rule, skip the shot; the ceremony is more important.

Be quick. Nothing irritates people more than a photographer who takes up too much of their time. They're here for the wedding, not the photos, so make sure you're quick. One or two minutes to pose people and then one or two shots per pose are good rules to go by. This is why it is especially critical to have a plan. Without it, you're almost certain to strain the patience of the most even-tempered of guests.

Stay out of the way of the pros. The Millers recount a wedding a few years ago during which a guest with a camera actually asked Darlene to move out of the way while she was busy posing the wedding party. Don't be guilty of that sort of behavior. Professional photographers earn their money by guaranteeing high-quality pictures that will last a lifetime. When someone interferes with their work, the consequences can be extremely unpleasant for all concerned. Stay out of their way. You wouldn't like it if someone walked into your office and got in your way while you were designing widgets or repairing cars or whatever it is you do for a living.

That said, most professionals are more than willing to work side-by-side with amateur photographers; some even encourage them to participate. To get things started off on the right foot, introduce yourself to the photographer before he begins working and tell him what you'd like to do. Ask him if there are any guidelines or specific rules he has that you should be aware of. Let him know that you're trying your best to stay out of his way. Nearly all pros will appreciate your sensitivity and tell you how you can best work with them. Some might even suggest shots for you to try.

Dire warning. Should you be asked to play the role of professional photographer at a wedding, we urge caution. It's not nearly as easy as it looks, and you stand a good chance of ruining one of the most important days of the new couple's life. Remember that a professional photographer has talent, training, knowledge, and years of experience. You have a cool camera and an invitation to a wedding. There's a world of difference. If you start to think that you'd like to do this as a career, that's great: Go to school, and apprentice with an experienced photographer. Be a pro's "gopher" at a few hundred weddings and shoot about a million photos of a little kid on a pony. In other words, learn your craft and pay your dues, just like the pro did.

A Wedding Photo Checklist

After your first 50 or so weddings, the routine will become ingrained. Until then, though, you're better off keeping a checklist to remind you which pictures you want to shoot and when. By the time you add in assorted candids and several family groupings, you'll probably want to end up with a total of roughly 80 to 90 usable shots for a typical wedding. Be prepared to shoot around 200 pictures to get 80 to 90 good ones.

Before Ceremony
- Bride alone in dress
- Bride touching up makeup
- Bride with mother
- Bride with maid of honor
- Bride with bridesmaids
- Bride with both parents
- Bride putting on garter
- Bride with father
- Groom alone
- Groom with best man
- Groom and ushers putting on boutonnieres
- Groom with his parents

At Ceremony
- The altar and decorations
- Ushers escorting guests
- Minister, groom, and best man at altar
- Processional
- Bride/father walking down aisle
- Father giving bride away
- Exchange of rings
- Bride and groom kissing
- Bride and groom coming up aisle
- Bride and groom outside w/guests
- Bride and groom getting into car
- Bride and groom in car, waving

Before Reception
- The newlyweds
- Bride and attendants
- Groom and attendants
- Entire wedding party
- Bride/groom with child attendants
- Bride with her immediate family
- Groom with his immediate family
- Both families together
- Bride's and groom's hands/rings

At Reception
- Bride and groom getting out of car
- Bride and groom's entrance
- The receiving line
- The bridal party's table
- The parents' table
- The musicians
- Toasts
- The guests' tables (assorted candids)
- Bride and groom's first dance
- Bride dancing with her father
- Groom dancing with his mother
- Bride dancing with her father-in-law
- Groom dancing with his mother-in-law
- Both sets of parents dancing
- Guests dancing
- The cake
- Bride and groom cutting the cake
- Bride and groom feeding cake to each other
- Bride tossing the bouquet
- Groom tossing the garter
- Guests throwing birdseed or rose petals
- Bride and groom getting into car
- Bride and groom waving good-bye from car

A talented photographer can breathe new life into standard wedding shots. Clockwise from left: A young bride gazes pensively off-camera; a bride and her mother pose for a portrait; a bride and flowergirl in a lighthearted pose; the bride and groom go outdoors for the traditional toast.

A straight on, shoulder-height shot produces a stilted, "deer-in-the-headlights" photograph.

The entire feeling of a photograph can be changed by using your image-editing software to convert the image to grayscale.

Applying a vignette effect can soften a photo and focus the viewer on the subject.

Small circles of light called a flare effect can add interest and give your photo a timeless character.

Post Wedding Treatments. The real benefits of shooting digital become come into focus after the event is over. Because you have digital files, there are many different treatments, effects, and corrections you can apply to your shots to improve the story you want to tell. We've selected a few of the more popular ones to mention here, but there are literally hundreds of different things you can do. Before you start fiddling with your photos, however, make a working copy of all your images. Many of the things you try will not work, so you'll want to go back and get the original and try again.

Cropping. Look carefully at your shots and identify anything that draws attention away from the subject. Is the bride too far away? You can easily crop and enlarge the picture to remove the extra background. If you've taken high-resolution pictures, you can generally do this without degrading the image. Try to enlarge it too much, however, and you'll get a grainy, jagged print.

You should also look carefully for distractions at the edges of a photo. See Uncle Ernie's arm waving to the camera during the processional? Cut it off (figuratively speaking, of course). Is that Aunt Martha's leopard-skin jacket hanging on a coat hook next to the groom? Better remove it altogether. An alternative to cropping is to intentionally blur the nonessential parts of the photo, which we'll cover later.

Tonal and color correction. Many interesting and evocative effects can be achieved by applying different tonal treatments. Sepia-toned photos would be perfect for that 1940s theme wedding your friend just had. Black-and-white (grayscale) photos are also a good choice for some shots. Your choices will be limited by your graphics package, so be sure to experiment *before* the wedding. Whatever you do, be careful not to overdo it; it's better to intermingle many different types of shots than to create an entire album with the same tone. The former draws the viewer in, but the latter quickly becomes tedious.

Red-eye removal. A wedding should be a joyous occasion, and the photos should reflect that joy. Red-eye, on the other hand, makes your subjects look possessed. The best way to correct it is to avoid it in the first place, but sometimes it just happens. Thankfully, most photo-editing packages now have very effective red-eye correction features. If your photo-editing software doesn't offer this, you may want to think about purchasing one that does. Sooner or later, you're bound to need it.

Special effects. Most photo-editing packages come with a slew of special effects. Effects such as blur can change the whole mood of a picture. Many of the effects won't be useful for wedding photography, but two we highly recommend are vignette and lens flare.

A **vignette** is a circular or oval shot with edges that fade out. Use the technique to mask a poorly framed picture by de-emphasizing the edges and focusing the viewer's attention on the subject. This effect can also be used to create a soft and wistful tone for pictures such as the bride in a contemplative pose. Another good use of vignette is a photo of the rings or of the bride and groom's hands with rings.

Lens flare refers to small (often hexagonal) circles of light caused by reflections inside the lens when you shoot into the sun (or other bright light source) while using a small aperture (the opening in the lens of the camera). It's a dangerous effect because it can ruin a photo, but used properly (and sparingly), it adds an interesting quality to a photograph. This can be the perfect effect for outdoor, informal shots of the bride and groom or the children in the wedding party.

Less is more. Whatever you decide to do with your photos, we encourage you to exercise restraint. A good effect is like effective makeup; the less you know it's there, the better it is. Use too many effects or apply them with a heavy hand and you'll spoil your work.

Make It Timeless. Now that you've shot your friends' wedding, you have a couple of options. If you want to give them prints in an album, we suggest that you send your files off to one of the many online digital printing services. You could use your photo-inkjet printer to produce good prints, but they'll probably start to fade within three years. You can also burn the photos onto a CD-ROM and present the disc to the happy couple as a memorable wedding present. Programs such as Photo Elf (http://www.photoelf.com) and FlipAlbum (http://www.flipalbum.com) will take your existing photos and create a digital album that you can then place on a CD-ROM.

After you're finished with the wedding project, we suggest that you hone your skills by photographing kids' birthday parties. You'll get lots of valuable experience, and your next wedding will seem tame by comparison. LS

by Ronald Hocutt

Handy Handheld Cams

Digital Camera Options For Your PDA

A wise man once said that a picture is worth a thousand words. Of course, if the picture is grainy, fuzzy, and hard to see, its value becomes questionable. A digital camera option for your PDA (personal digital assistant) may not bring you up to the level of the "Oxford English Dictionary," but it can certainly add additional interest to your messages.

People use PDA camera add-ons for a number of applications. A real estate agent might take pictures to add to a listing, a businessperson can record the scribbled diagrams on the whiteboard at the end of a meeting, and many people send keep-in-touch emails with pictures to relatives or friends. The cameras can provide a degree of versatility to the PDA by letting the user easily create and transmit images without having to carry a separate camera and its accessories. PDA cams generally do not provide the versatility in terms of focus, effects, or resolution that a standard digital camera offers. However, with the price of these camera add-ons averaging about $100, they can be a good option for someone who wants to have it all (electronically speaking), travel light, and avoid breaking the bank.

■ **What's Available?** Although almost every PDA model has a camera designed to work with it, some are more popular than others. At present, the greatest number of camera options is available for the Handspring series of PDAs that run the Palm OS (operating system). There are similar accessory options for the Casio CASSIOPEIA, the Hewlett-Packard Jornada, and the Sony CLIÉ. Sony also makes a PDA that incorporates a digital camera directly into the device. The Palm line of products, the original handheld devices, has only one camera option available, and its maker, Kodak, has discontinued it (although it is still offered for sale through retailers such as Amazon.com).

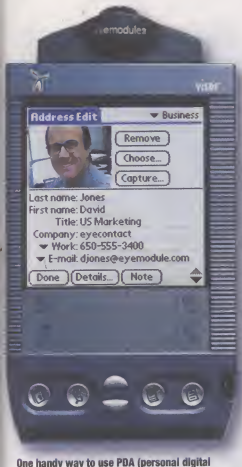
■ **How Do They Work?** A digital camera attachment for your PDA works the same way as a standard digital camera. The digital camera creates image files, and the files can be reviewed, manipulated, and stored in a variety of forms. Initially, the image files are stored in the camera's (or in this case, the PDA's) memory. You can erase the files and reuse the space, and you can alter the images with the help of photo-editing applications. As with a regular digital camera, any real file manipulation and long-term storage require the images to be transferred to a computer.

The PDA's CCD. Instead of film, the digital camera captures images on a silicon chip called an image sensor or CCD (charge-coupled device). The CCD is made up of light-sensitive diodes called **photosites**. Each photosite (there are millions on the CCD) records light intensity and brightness by accumulating an electrical charge used to illuminate a **pixel** (picture element). The pixels are used to create a bit map, which is then stored in the camera's (in this instance, the PDA's) memory until you transfer it to your PC or some other long-term storage medium.

File formats. The most common image format that the digital camera uses is JPEG (Joint Photographic Experts Group). File formats other than JPEG, such as TIFF (Tagged Image File Format), are available on the higher ranges of standard digital cameras, but generally, the JPEG format is the most popular with PDAs because of the smaller, more manageable file size it delivers, while still rendering a detailed photo. Most PDA camera attachments are designed to work most effectively with the JPEG format, and some will work *only* with that format.

■ **Features & Functions.** The PDA camera and the standard digital camera share some of the same features, and they also share some of the same drawbacks.

The cameras that are available for your PDA have limited ability to change the focus or to zoom in and out for close-ups. Generally, the focus is fixed, although in two of the available product options, there is a two-power optical zoom feature that allows for good close-ups, augmented in one case by a three-power digital zoom. Optical zoom refers to the camera's ability to use a moveable lens to capture close-up pictures without losing the resolution of the picture to a large degree of pixelation. **Pixelation** is the blocky effect that occurs when the distance between the color pixels in the image is too great. It is caused by trying to create a close-up of an image at too great a distance for the resolution of the camera. Digital zoom is a means that camera makers use to let



One handy way to use PDA (personal digital assistant)-based imaging is to include photos as part of your handheld's address book.

you zoom in while using software to smooth out the pixelation effects by adding pixels where they appear to be spread too thin in the image. A good quality standard digital camera should have enough resolution to make full use of its optical close-up features without sacrificing image quality, but this is rare in PDA camera add-ons.

Each PDA camera is designed to work with a specific PDA device, so no matter how good the camera itself is, it will always be constrained by the limitations of the PDA with which it is matched. That means that you must consider storage space for your images, as well as the battery life on your PDA, in relationship with the digital camera option you select.

Resolution and image size. Resolution generally refers to the size of the image the camera will create, measured by the number of lines or dots per inch that the camera can record and still render a sharp image at a given picture size. There are a variety of terms used to measure the resolution of the digital camera, but the most frequently used common denominator is the megapixel, which is a measurement of how many pixels, in millions, the camera will record on the CCD's photosites. (One megapixel is equal to roughly 1 million pixels.) Resolution is also often referred to using an expression of the dimensions of the image, so an image that is 640 x 480 has 307,000 pixels (640 multiplied by 480), or 0.3 megapixels.

Most of the handheld camera options limit you to a picture with a maximum resolution of 640 x 480, which is not a huge picture, but which is adequate for posting as a small image on a Web page or emailing a candid picture to a friend. That resolution lets you store about 40 images on a PDA with 5MB of RAM. The eyemodule for the Handspring has the ability to store pictures at a much smaller resolution of 160 x 120 pixels. According to the manufacturer, this allows for a storage capacity of approximately 500 very small black-and-white images in the same 5MB. A picture that size has limited clarity; however, many people use these as additions to the PDA's address book.

Memory requirements. When you are shopping for a camera to go with your PDA, keep in mind that many PDAs on the market come with approximately 8MB of RAM as available storage, and that available space is shared with any other applications you may be using. Although 8MB is adequate for the most common uses of the PDA, it can be a bit limiting in terms of the number of photos you can store on your device. In comparison, a midrange digital camera (available for about $300) would typically come with 32MB to 64MB of storage, letting you amass hundreds of low- to medium-resolution images before transferring them to your PC.

Most of the PDA camera options let you choose between black-and-white images (with lower storage requirements, especially at the lowest resolutions) and color. If you have a monochrome display on your PDA, though, you will not be able to view your color handiwork until you have synced with your PC.

When considering a PDA camera, you should keep in mind that the PDA is generally dependent on a PC for permanent image storage. In many cases the PC is also the primary mechanism for recharging the PDA battery, which can create a problem for travelers. Of course, this is already an issue for many digital camera users. Each camera's memory has a finite capacity for image storage, which requires the user to have some kind of external storage media. The storage device most people choose is a PC, because the different types of flash media available tend to be fairly expensive. Someone on vacation in Hawaii is probably not going to want, or be able to run out and get, more memory for storage; it's not as easy as buying an extra roll of film from the corner drugstore. The easiest storage solution for the traveler may be to carry a mobile PC along on the trip, although that presents another set of challenges for safe storage and transportation.

The eyemodule2 is the latest digital camera for the Handspring Visor series.

■ **Take The Photo.** The PDA cameras work with the PDA to create and store images. Some of them come with their own power supply (batteries) so they don't run down the battery on the PDA. Typically, the camera unit attaches to the device through an expansion slot on the PDA. You take pictures by holding the PDA in the palm of your hand and pointing at the subject. The image appears on your PDA's screen; if there is a focus capability, you can adjust the picture you see on the screen until you are satisfied with the image. You capture the image by pressing the Capture button on the camera (or, on some models, by using one of the PDA function buttons) and holding the PDA very still.

One common complaint about PDA cameras is the slow image-capture speed. Some handhelds take as long as 9 seconds to capture and record the digital image. This is a long time compared to a standard digital or film camera, and a clear digital picture depends on the user being able to hold the camera still during the capture time. This can be very awkward, depending on the type of PDA you are using.

One advantage of the PDA camera over standard digital cameras is its ability to take advantage of the synchronizing cradle to quickly and easily transfer the images to the PC. Because the cradle is often already in place, as is the software, transfers can be done spontaneously, without plugging an additional cable into your PC. Of course, a potential pitfall with

The eyemodule is the lowest priced PDA (personal digital assistant) camera option on the market. The next generation eyemodule2, slightly more expensive, offers higher resolution pictures and the ability to capture brief video clips.

a PDA, especially if it's an older model, is the unfortunate loss of all stored data when the device loses battery power. If they're not backed up to your PC's hard drive, all of your pictures could be lost if you let the PDA's batteries run down.

■ **Examine Your Options.** Now that you're familiar with what a PDA camera can do for you, let's take a look at some camera options and the features available with each. *(NOTE: Each of the camera options requires you to install software on your PC. The camera application must be synced with the PDA before the camera option is usable.)*

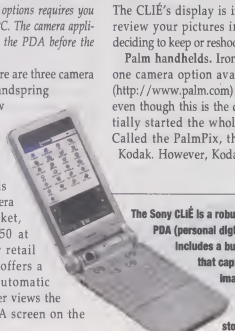
Handspring PDAs. There are three camera options made for the Handspring PDA models (http://www.handspring.com), including the original eyemodule by Block Products (http://www.eyemodule.com). This is the lowest-cost PDA camera attachment on the market, retailing for around $50 at Amazon.com and other retail Web sites. The camera offers a fixed-focus lens with automatic exposure control. The user views the picture through the PDA screen on the Handspring and presses a Capture button on the front of the handheld device. You can immediately view the image that you have captured and erase an image that you do not want to keep. Images can be transferred by beaming between compatible PDA units or by syncing with the PC by means of the PDA's cradle. The original eyemodule has a maximum resolution of 320 x 240 in either black-and-white or color.

The newer eyemodule2, also for the Handspring PDAs, offers higher resolution images at 640 x 480. It also lets the user set the camera to take pictures at set intervals to make a time-lapse set of images or to take self-portraits. The eyemodule2 also captures brief video clips, but don't count on smooth, lifelike video. The unit retails for approximately $150.

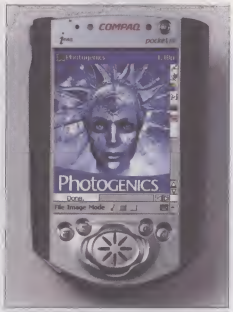
Sony PDAs. Sony (http://www.sony.com) makes a plug-in module for most of its older PDA models. Retailing for approximately $150, the CLIÉ Memory Stick Camera makes use of the Sony Memory Stick storage media to capture color images up to 320 x 240. It runs off the battery power of the PDA itself and has a rotating lens feature that lets you take pictures from unusual angles. It does not let you change focus or zoom.

Sony also offers the higher-end CLIÉ PEG-NR70V, which incorporates a variety of PDA options, including a digital camera, into the device itself. The resolution is limited to 320 x 480, which is a bit disappointing in a $600 device. (Of course, if you are mainly interested in digital photography, you can get a good digital camera with 2 to 3 megapixels of resolution for about the same price as the PDA.) The CLIÉ's display is in color, so you can review your pictures immediately, before deciding to keep or reshoot them.

Palm handhelds. Ironically, there is only one camera option available for the Palm (http://www.palm.com) series of handhelds, even though this is the company that essentially started the whole PDA revolution. Called the PalmPix, the unit is made by Kodak. However, Kodak has discontinued this camera, which will leave Palm users with no alternative but a standalone camera.



The Sony CLIÉ is a robust and feature-rich PDA (personal digital assistant) that includes a built-in digital camera that caputes 320 x 480 images. The camera and PDA use the Sony Memory Stick data storage media.



Unbeknownst to many, one can indeed edit photos on a handheld. Photogenics for the Pocket PC (Idruna; $50; http://www.Idruna.com) is one of the most robust and full-featured image editors you'll find for a PDA (personal digital assistant).

HP, Casio & Other PDAs. Hewlett-Packard (http://www.hp.com) and Casio (http://www.casio.com) also each offer a proprietary camera option for their PDAs. They tend to be fairly expensive and have about the same capabilities as the models made for the Handspring and the Sony. These are the only options available for the HP Jornada or the Casio CASSIOPEIA, so if you're not satisfied with them or if they're too expensive, your only other choice is a standalone camera.

Although it's not available at press time, the NexiCam digital camera for the Compaq iPAQ is due out "soon" (according to Compaq's Web site, at http://www.athome.compaq.com) and is said to feature a resolution of 800 x 600.

■ **Useful, But Limited.** Depending on the type of PDA you use, a digital camera option can be a useful accessory. However, with the options limited for each PDA, you may find that you do not have the range of choices that you might have thought. Generally, you will get better pictures with a standard digital camera, but the right PDA with a camera attachment can give you the ability to capture adequate pictures on the run in a compact and easily portable unit. LS

by Bert Nixon

Capture The Mind's Eye

How Digital Video Camera Recording Works

To the uninitiated, DV (digital video) cameras may seem daunting, and we don't just mean the price. After all, many of us still remember shooting reels of film, not cartridges, and for most of us, recordable videotape still means VHS. However, millions of consumers are adopting DV camcorders, and for good reasons. DV is more portable, offers higher quality, and is immensely easier to edit. The mysterious aura of complexity that often surrounds digital video is by and large unfounded.

If you've ever used a VHS, S-VHS, 8mm, or Hi8 camcorder, you're already 80% of the way to understanding DV models. Most controls and functions are the same. Only the recording mechanism is substantially changed. Let's open up the case and look at DV camcorders. In the process, we'll drop a few pointers to help guide you toward selecting the right camcorder or making better use of the one you have.

■ **Into The Lens.** The journey from tangible object to intangible pixels starts at the lens using the same method you use every day without knowing it. Your eyeball takes the light being reflected from objects in front of you and passes this through your lens, which bends the light and focuses it on your retina. Similarly, a camcorder's lens focuses light onto a sensor called the CCD (charge-coupled device).

Exposure. More specifically, light passes through the lens and begins to refract down to a single point called the **focal point**. Beyond the focal point, the image starts to expand as a reverse image until it reaches the CCD. Right behind the lens, though, is the aperture, a dilating mechanism similar to the iris in your eye. The aperture controls how much light is allowed to pass from the lens on into the camera. In bright conditions, the aperture becomes narrower to allow in less light so the image will be properly exposed. Aperture dilation is measured in f-stops. The wider the lens' maximum aperture, the lower its specified f-stop will be. Thus a camcorder with an f/1.6 lens will be able to gather more light and yield better footage in dim conditions than an f/2.8 lens.

If you wonder why poorly lit DV scenes appear to have gray or purplish noise in them, it's because each cell in a CCD requires a certain amount of light in order to compute a proper value. Without enough light, the cell has no information to report. The camera's processors must have something to record to tape, so garbage data is applied, which looks like shifting "noise" on-screen.

In close. The distance from the lens to the CCD is called the **focal length**. As you know from holding a magnifying glass over a page and drawing it closer to your eye, moving the lens position in relation to the sensor can make the image appear larger. With DV cameras, increasing the focal length optically magnifies the image. (This shouldn't be confused with digital zoom, which merely enlarges the pixels at the sensor's center.) Most DV camcorders feature a lever conveniently located under the user's index or middle finger. This lever activates a motor inside the camera that moves the lens. Not all motors are the same. Almost like car brakes, some are fast, some slow, and some start and stop with jerky movements. In general, we prefer slow, smooth zoom mechanisms.

One last note about lens mechanics: Aperture also controls **depth of field**, the range of distance in which the scene the camera sees is in focus. Serious videographers take great pains to control depth of field to help draw attention to certain details or subjects in a scene. For example, you might want the person you're filming standing 8 feet away to be in focus while the group of other people 4 feet behind her remains slightly blurry. The wider the aperture, the narrower the depth of field. So an f/1.6 aperture may give you only a few inches of depth of field while f/16, with the aperture closed down to almost a pinhole, would yield many feet. Be aware, though, that a wide aperture in bright sunlight may render subjects that appear to be in a nuclear blast, with most of the rest of the world whited out into oblivion.

■ **Meet The CCD.** The CCD is a silicon chip blanketed with hundreds of thousands of light-sensitive diodes called **photosites**. These photosites are arrayed in a grid that approximately

Longer lens designs and focal distances allow for greater optical image magnification. The Canon ZR50 shown here uses its horizontal real estate to achieve 22X optical zoom, far more than the 10X found in smaller, more expensive vertical units, such as the Elura and Optura.

corresponds to the grid of pixels that comprise the image displayed on your monitor or printed page. Ideally, each photosite would detect the exact color hitting it, but this isn't how computer systems work. Instead, levels of red, green, and blue are mixed to obtain the full spectrum.

To obtain only red, green, and blue values for each pixel, a checkered filter is placed immediately before the CCD that allows only red, green, or blue to pass through at any given point. In this way, any small area within the image will be made of red, green, and blue dots of varying intensities. These values are averaged and the gaps between pixels are filled in with interpolation, wherein the camera's software creates new pixel data based on surrounding "true" pixels.

Interpolation processes are fairly good, but professionals demand more accuracy. This is why many DV camcorders costing more than $2,000 use three CCDs instead of one. Rather than applying a color filter, these three-CCD models use a prism to split the light beam. Each CCD collects red, green, or blue light, and the data from all three sensors is composited to create a full-color image. This method yields better color accuracy but chews through more power and requires much more space.

As you might expect, the size of the CCD dictates how many photosites can reside on it, which in turn dictates the maximum resolution in each video frame. CCDs measure 1/2 inch on average, with 1/3-inch designs on cheaper camcorders and 2/3-inch chips on higher-end models. NTSC (National Television System Committee) specifications, the standard for professional video in North America, call for 525 horizontal lines of resolution in video. With CCDs now yielding more than 1 million pixels, the number of photosites may be seen as overkill. But keep in mind that many photosites can comprise one pixel, and the more photosites there are in a pixel, the better the odds that its color value will be accurate.

■ **From Sensor To Tape.** So far, the basic principles we've covered apply equally to both analog and digital camcorders. The key difference between these two formats is that analog camcorders store video to tape as magnetic patterns whereas digital camcorders convert each pixel into a long string of color information made up of binary data (0s and 1s).

Every time an analog tape is copied or (to a lesser degree) played, electromagnetic signals are sent through the tape, which add information to the media. It is commonly believed that copying analog tapes deletes data, but in fact the opposite is true. These signals add stray data to the tape, thus introducing snow or other distorting artifacts. Binary data sequences in DV footage are immune to this distortion, which is why you can copy a DV file 1,000 times and never experience any image degradation.

Another difference between analog and digital is the resolution of which each format is capable. Standard VHS offers 230 to 250 horizontal lines while DV and Sony's Digital 8 formats generally offers 500 to 520. The analog Hi8 format can achieve about 400 lines but still is prone to all of analog's drawbacks.

When you want the most precise images possible, turn to a three-CCD (charge-coupled device) model, such as this Sony DCR-VX2000. The camera uses three 1/3-inch CCD sensors to handle red, green, and blue light data rather than one CCD making do with a color filter and artificially interpolated pixels.

Analog and digital camcorders both capture video with a process called interlacing. Early TV sets could only display 30fps (frames per second) on its screen, which is fast enough to eliminate the illusion of flicker. These TVs, however, ran on a 60Hz power cycle, meaning the on-screen image is refreshed, or updated, every 1/60th of a second. The electronics demanded refreshing the screen every 1/60th of a second, but the total number of frames could only be 30 per second.

Engineers had to figure a way to display one frame every two refreshes, and interlacing was their answer. Interlacing used a process by which every other line of an image was captured roughly every 1/16th of a second. In the first frame, all of the odd lines were captured, then in the next frame, all of the even lines. These two frames were compiled to create an entire image that flashed on-screen approximately every 1/30th of a second.

Unfortunately, interlaced video is prone to blurring and stray artifacts where the odd and even fields don't perfectly mesh, particularly during editing. Good digital camcorders solve this problem by offering a progressive scanning mode wherein all lines of the scene are captured in each frame every 1/30th of a second. Progressive scanning is not available on analog camcorders, which is why you don't see analog camcorders with still photo capture capabilities: Any given interlaced frame contains only half of the total image lines.

With analog camcorder formats, you often need to use the camcorder itself as a playback device in order to watch footage on a TV or monitor. With DV camcorders, this is still an option, but the conventional means for handling video is to output the tape's data over an IEEE (Institute of Electrical and Electronic Engineers) 1394 connection and capture it to a computer's hard drive. From here, the footage can be played, edited, and recompiled for output as a video CD, a streaming Web file, or any other number of viewing options.

■ **Beyond The Essentials.** We've covered the basics of how DV is recorded. Of course, there are other details, which we touch on elsewhere in this issue. Hopefully, we've shed enough light on the inner workings of DV camcorders to demystify them and help show you that DV is the technology you need to be using now and in the future. LS

by William Van Winkle

Compiled by William Van Winkle

The Digital Video Camera

Although it's a big step up from your mom and dad's camcorder, the digital video camera shares similar features with the nearly extinct VHS clunker. Here's a look at some of the features you should expect to find when you purchase a digital video camera.

Manual control buttons
Easy access to manual features, such as focus and exposure, are part of what separates the low-end camcorders from high-performance ones.

Record/zoom controls
All cameras feature basic recording and zoom controls, but not all cameras place your fingers comfortably over these buttons and levers.

Lithium battery
All camcorders have some kind of indicator to say how much battery life remains.

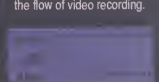
10X optical/120X digital zoom lens
Optical zoom is what actually brings the camera's subject closer and is what you should base your zoom buying considerations on. Digital zoom involves artificially magnifying and interpolating pixels, which involves creating new pixels based on the color information of nearby pixels.

Viewfinder
If you make regular use of the LCD (liquid-crystal display), the viewfinder is an unnecessary feature. The viewfinder's only real advantage is that it consumes far less battery power than the LCD. The TRV-50 features a color viewfinder; most lower-end cameras use black and white. If your eyesight is slightly off, make sure your viewfinder features a diopter to help compensate.

Pop-up lamp
Like the pop-up flash on many still cameras, the pop-up lamp provides short-range illumination for low-light scenes. Keep in mind that lamp use takes a heavy toll on battery life.

Swivel LCD
The TRV-50's expansive 3.5-inch LCD is larger than most camcorder screens, and Sony LCDs tend to compare well for viewability in bright outdoor conditions. Although a larger screen can be easier on the eyes, in practice we've found it to not matter much during regular use. However, the TRV-50's LCD is actually a touch screen. This makes menu navigation far easier than the usual method of pressing forward/back/enter buttons.

Flash Memory
Many DV camcorders now come with slots for flash memory, such as Sony's Memory Stick or smaller SecureDigital cards. These are used for capturing still photos. The images can then be removed and quickly read by a PC's flash card reader without interrupting the flow of video recording.



Stereo microphone
Integrated stereo microphones are usually very sensitive and great at capturing nearby conversation, as well as distant sounds of birds or traffic. However, watch out for cameras that are so sensitive that the sound of the unit recording obtrusively shows up in the footage.

Upon Further Review

What To Look For In A Digital Camera

It's that time. You have room on the credit card, and your head is filled with visions of putting together masterpieces of modern digital videography. So, you head to the local electronics megastore, find yourself in an aisle filled with dozens of DV camcorders, and suddenly realize you have no idea what you're really looking for.

Relax. As with any other big purchase, finding the right camera is 80% education and 20% perspiration. We can offer plenty of assistance with the first part, but you're on your own when it comes to wrangling with salespeople and signing on the dotted line.

■ **Form Factor & Layout.** If a car seat makes your back hurt, you won't drive the vehicle. Similarly, no camcorder element is more important than how the device sits in your hands.

Nearly all camcorders fall into two basic body types. The horizontal "shooter" style is the most traditional design, wherein a larger body design allows for longer lenses and bigger LCD (liquid-crystal display) screens. Vertical "uprights" are generally much smaller and tuck into the cup of your hand. Verticals are more convenient because they can usually fit into a jacket pocket. (The most current designs from Sony even fit in a shirt pocket.) Alternatively, horizontals tend to be better for people with large hands because the controls are more spread out.

The one rule-breaker in this regard is Sharp's NZ camcorder series. The NZ family is a bit smaller than a thick paperback book, with the large LCD display built into one piece on the left and the lens and primary camera controls on another piece on the right. Both pieces are joined and swivel at the center.

Hands-on. Make sure you hold the camera and play with it for at least several minutes before you buy it. If the controls don't match up with your fingertips well, the device will be uncomfortable to operate. Because of a smaller form factor, many upright cameras feel cramped. (Also keep in mind that because uprights are operated with one hand, they are much more prone to body motion and jitter than a horizontal design.) JVC's GR-DVP has been one noteworthy exception for us, thanks largely to the zoom control being turned into a ring that encompasses the Record/Pause button underneath the thumb.

Most people have very good control over their thumb, index, and middle fingers. Each of these three fingertips should control nearly all of the camera's primary controls, zoom and Record/Pause being foremost of all. If you have to stretch or fumble to reach these, you'll not only jiggle the camera while shooting but also get tired fingers in short order. Watch out that your fingers don't cover important camera components, including the integrated microphone, lens, or infrared sensor when you relax.

Fastener. Not least of all, be sure that the strap is comfortable. If you're having trouble reaching the buttons, try loosening the strap a bit. If the strap is too loose, though, the camera may wiggle too much in your hand and become hard to grasp. If you simply can't get comfortable with a camera, ditch it. No amount of cool features will compensate for jerky shooting and a dread of prolonged recording.

■ **The Sensor.** Consumer-level DV camcorders use a CCD (charge-coupled device) sensor located behind the lens to gather light into cells and convert it into the pixels that comprise each frame image. More CCD cells mean more pixels, which in turn means higher resolution and better-quality images. In theory, the larger the CCD sensor, the better the results, but so many advances have been made in signal processing and how pixel data is gathered that sensor size isn't the priority it once was.

What does matter is the number of pixels the sensor can record. This represents the number of "effective" pixels, which is often less than the number of total pixels, or cells, present on the sensor. Many low-end cameras have 460,000-pixel sensors (0.46 megapixel). Midrange units often use 680,000-pixel designs (0.68 megapixel), and high-end units should be using sensors featuring in excess of 1 million pixels (1 megapixel).

Most **prosumer** (blend of professional and consumer) and professional DV cameras (generally starting at $2,000) use three sensors instead of one. The optics break the incoming light into red, green, and blue components, sending each to its own sensor. This results in greater image detail and color accuracy, but such quality levels are usually more important for commercial studios than for home use.

■ **Tape Formats.** When it comes to consumer digital video, there is MiniDV and then there is Sony, and occasionally the two overlap. Nearly all non-Sony consumer-level digital camcorders use MiniDV format tapes. MiniDV tapes are small and lightweight, easily fitting in your palm. The format can capture up to 525 lines of resolution, although the camera may record less, and features twin 16-bit audio channels for high-quality stereo. MiniDV records in DV format, which is a compressed file type, but only half as compressed as the MPEG-2 (Motion Picture Experts Group-2) technology used in DVD movies. To most viewers, DV's compression is invisible, save perhaps in fast-moving subjects or very fine textures.

Digital8 is a rival Sony format designed to provide MiniDV-like functionality and performance while still offering some backward compatibility with older analog tapes. Digital8 supports 525 lines of resolution, but it can also record onto Hi8 and 8mm analog tapes. Users may also play their old Hi8 or 8mm tapes in a Digital8 camera and export the analog footage via IEEE (Institute of Electrical and Electronic Engineers) 1394 to the computer for digital encoding. This is a far easier method of doing analog-to-digital conversion than using special analog capture cards.

Sony's other proprietary format is MICROMV. MICROMV tapes are 70% smaller than MiniDV, enabling the market's tiniest camcorders. With the reduction in size comes a hit in quality, though. MICROMV camcorders record in MPEG-2 format, so video compression is considerably more pronounced. Currently, Sony's Movieshaker application is the only video-editing application that will recognize MICROMV. To use footage in another application, the MPEG-2 footage must be converted into a more widely used editing format, such as AVI (Audio-Video Interleaved) or QuickTime.

■ **Zoom.** There are two kinds of zoom used with digital camcorders: optical and digital. Optical is the type of zoom you're accustomed to from the world of film. By shortening or elongating the length of the lens barrel, you can optically magnify or zoom out from a subject without moving the camera. For example, the 20X optical zoom in Canon's GL1 is equivalent to an SLR lens with 40mm to 806mm telephoto capabilities. If you've ever used an 800mm lens, you know that that's some powerful magnification, and you would never think of trying to shoot at such a range without the assistance of a tripod. Otherwise, everything in the field of view would shake about and make you ill.

It seems odd, then, that every DV camcorder you see sports zoom ratings the likes of 120X, 300X, and even 700X, right? This is digital zoom, which is nothing more than a game manufacturers play to try and captivate the uninformed buyer. Digital zoom takes the pixels at the center of the frame and magnifies them to fill the screen. All this does is make the pixels look bigger. You're not actually adding any new information to the scene. Optical zoom will let you discern the texture of someone's skin; digital zoom will make the super-magnified bridge of someone's nose look like a staircase. In our opinion, digital zoom is a wholly useless feature you would do best to ignore.

In reality, most users don't need anything above 10X optical zoom. In fact, the necessity of using a tripod kicks in somewhere around 7X. If you really need to get closer to the subject, do what professionals do: Get up and take a few steps toward the subject. The only time stronger magnification is needed is for outdoor shooting, as for capturing wildlife or close-ups of sporting events.

■ **Stabilization.** Virtually all DV camcorders now feature stabilization technology to help counter the slight shaking that inevitably accompanies shooting with a handheld camera. As with zoom, there is optical and digital stabilization. Optical entails building tiny gyroscopes into the camera's lens system. Digital stabilizers use circuitry and software to simulate the same effect, but digital stabilization often uses blurring to help preserve the appearance of non-motion. This is why if you truly value clarity, you'll automatically be pushed into buying a high-end camera, such as Canon's Optura 100MC, which features optical stabilization. Optical performs better than digital, but if you have digital stabilization and need to preserve clarity, turn the stabilization off and use a tripod.

The reason you don't find optical stabilization in uprights is because the gyroscope system significantly enlarges the size of the lens. Planting an Optura lens on, say, a Sony upright's body would look ridiculous and defeat the purpose of having a small form factor.

■ **Interlaced vs. Progressive.** How each frame in your video is constructed can affect the image's final quality. Traditionally, each frame of video has been constructed through **interlacing**, a process wherein one frame records the even lines while the next frame records the odd lines. At 60fps (frames per second), the result is comparable to watching television. However, interlacing can introduce blurry artifacts, a problem that becomes even more pronounced when saving still images.

Progressive scanning saves all of the lines in a scene in each frame of film. Because there is twice as much data per frame, this capture method requires more bandwidth within the camera's recording system. Fortunately, advances in chip technology are enabling progressive scanning in increasingly affordable cameras.

■ **Lighting.** Just as your eyes can't perceive anything in pitch darkness, neither can a camcorder's CCD. Similarly, just as some people's eyes can see better than others in dim conditions, the same is true of camcorders. Most manufacturers rate the minimum amount of

As tiny as it is innovative, Sony's IP7BT is the first digital video camcorder to make use of Bluetooth wireless connectivity. Unfortunately, Sony cut corners to enable this alluring camera, so we're hoping that the next version will keep all of the IP7BT's best advances while reintegrating Sony's usual level of quality.

ambient light necessary to capture a scene effectively in terms of lux. One lux is the amount of light given off by a candle as measured from a distance of one meter.

An average sensitivity for a low-end camera is about 100 lux. Some manufacturers will skew their light sensitivity ratings by dropping the number of frames per second. If the CCD is allowed a longer time to gather light, the image will improve. But this may drop the number of frames per second to 10 or less. You may see cameras rated down to 1 lux or less, but the footage is likely to appear exceptionally grainy and motion will appear to have a strobe-like jumpiness.

Arguably the best starter camera on the market, JVC's DVL1200 dispenses with many extraneous features and delivers what users need most: bright picture, a high-resolution CCD (charge-coupled device), and a very affordable street price.

Many manufacturers use a small infrared lamp to illuminate scenes. Infrared is invisible to the human eye, but the CCD can pick it up with no problem. This is how night-vision binoculars work. Until recently, nearly all night-vision systems in camcorders appeared as black and white or green and white. The latest crop of models is moving to full-color infrared. Night vision is usually only found in midrange and high-end units.

Some camcorders feature pop-up flashes, but these are designed for still photo use, not to illuminate video scenes. A few camcorders, such as the Panasonic PV-DV402, use a lamp to provide continual lighting. Lamps are one feature that have not migrated well from the analog to digital camcorder markets, probably in large part because lamps put a significant drain on the battery, and small-format DV camcorders are lucky to squeeze out two or three hours of runtime under the best of conditions. If you need additional lighting, most midrange and high-end cameras feature a hot shoe for plugging in accessories, such as high-power lamps and directional microphones.

■ **Microphones & Audio.** Ideally, a camcorder's internal microphone should be positioned right below the lens. This way, sound is picked up coming directly from the subject. Many horizontal models use this design. Unfortunately, an even greater number of models position the microphone on top of the camera, pointing toward the sky, presumably because of form factor constraints. This has a tendency to mute audio a bit and blur the left/right stereo separation.

If you care about audio quality, find out first off if the manufacturer makes a directional microphone for the camera's hot shoe. Beyond this, see if there is a dedicated jack for an external microphone. An external mic can be clipped onto a subject, as during an interview, to assure the best possible audio clarity. Another useful feature is a headphone jack, which will give you a much more precise sense of what is being recorded so you can adjust the camera and external microphone as necessary.

Many cameras allow for an additional audio track to be dubbed onto existing tape footage. This approach is imprecise at best and can be handled much more effectively in editing software on the desktop PC, so don't take dubbing capabilities into account when deciding on a camcorder.

On the other hand, the ability to manually control audio levels can be a real benefit. If you're shooting two people having a heated conversation and they suddenly fall silent, the camera may boost the recording level in search of some sounds to record. The resulting hiss and boosting of ambient room sounds can be very annoying. Also, many cameras are prone to having a microphone and automatic recording level so sensitive that the sounds of the camera's internal recording mechanisms are plainly audible on the tape. Always test a camera for this flaw before you buy it. We've heard high-end as well as low-end units do this.

■ **LCDs.** Every DV camcorder features at least one color LCD on which users can watch what the lens is seeing or view previously recorded footage. Manufacturers are fond of boasting about larger LCD screens. For some users, this may be a plus. Larger screens make for easier viewing, particularly if you want to be in the scene and are trying to watch the LCD from a distance. With you behind the controls, however, our experience has been that a 2.5-inch screen serves just as well as a 3.5-inch one. In fact, smaller screens can be better because they reduce the unit's cost and allow for a smaller, lighter design.

Be sure to get an LCD that swivels with 270 degrees of motion. This way, you can flip the screen over 180 degrees and see the scene (now automatically mirrored so as to be right-side up) from in front of the lens. You also want to be able to hold the camera up above a crowd of people so that the lens faces forward but the screen swivels downward so you can continue seeing the action.

Good LCD screens use an anti-glare coating and are designed to reflect as little ambient light as possible. The less light that's reflected, the clearer the display will look under bright outdoor conditions.

Viewfinders still appear on most camcorders, but users are slowly realizing that this is generally a redundant feature. The only times you really need a viewfinder are if your environment is too bright to see the LCD display or if you want to turn the large display off in order to save battery power. Viewfinder LCDs come in color or black and white, and we really don't recommend one over the other because we never use them. Good viewfinders will have a diopter level for adjusting to non-20/20 vision. As with still cameras, using a viewfinder while wearing glasses is a pain.

■ **Still Photo Capture.** If you're fond of capturing snapshots to email friends and family, consider having your camcorder double as a still camera. Nearly all DV camcorders have this ability. The variables are where the images are being stored and at what resolution. Low-end camcorders often record the image to tape. This can yield poorer quality on interlaced models and locating individual shots on the tape can be difficult and time-consuming. The majority of models in the midrange and high end use flash memory cards, usually MMC

(MultiMediaCard) or SD (Secure Digital), save for Sony, which invariably uses its proprietary Memory Stick format. Flash memory cards have the advantage of speed and portability. You can simply remove them from the camcorder and pop them into your PC's flash memory reader without having to download from the camera.

Pay attention to the still photo's resolution. Most camcorders only capture at 640 x 480 resolution, which is barely large enough to fill a significant area of your monitor and wholly insufficient for printing to paper. One the other hand, camcorders that can capture 1-megapixel or higher images will produce decent 3- x 5-inch images or possibly even 5 x 7 inches. Make sure, though, that these resolutions are optical and not interpolated because interpolation will not offer the same level of quality.

■ **Manual Control.** With advances in chip design and overall camera quality, the AE (auto-exposure) modes—such as sports, nighttime, or interview—found on even low-end camcorders are now quite good. However, you may want even more precise control over factors such as focus, shutter speed, and exposure. This may be necessary, for example, if you're following a subject as he walks away from the camera through light and dark areas. Autofocus mechanisms in particular are infamous for having difficulty focusing in low-light conditions, and a manual override would immediately solve this problem. Similarly, AE can lose a person's face if he's standing against a bright background.

Most low-end camcorders don't provide much in the way of manual control. If these are features that you anticipate using frequently, make sure that the camera's menu system is easy enough for you to adjust the manual settings quickly while shooting. A 20-second adjustment process every time you need to change a setting is only going to make you hate the camera.

■ **Analog Input.** Many cameras feature S-video and A/V cable inputs. For users who want to convert VHS, 8mm, or other analog tape footage into digital, these analog jacks are an easy way to perform the process. Simply record the analog feed onto a DV tape and download the recording into your PC for editing.

■ **Wide Screen.** If you plan on capturing footage for viewing on screens with a 16:9 aspect ratio, see if your camcorder supports a 16:9 mode. This mode can be simulated with editing software, but it may be simpler and yield more accurate framing if you apply it from the camera as you shoot.

■ **Digital Effects.** One Sharp representative we spoke with referred to these as "one-use" features. Users will try them, discover just how useless they are, and never use them again. These include effects such as "wipes" between scenes, sepia toning, conversion to black and white, strobing, and so on. Digital effects might also include sound effects. Press a certain button and the sounds of laughter, applause, screaming, and such will be dubbed onto the tape. More recently, video footage can be set inside a frame of waves, trees, or other patterns.

Sharp's trademark swivel design is back in black. Sharp ignores integrating a viewfinder that few people ever use and instead offers a 3-inch LCD (liquid-crystal display) designed for outdoors viewing. Sharp's images are clear and vibrant, and the camera is a snap to use.

In all cases, these effects are meant to be fun, but the results are both cheap-looking and, more often than not, annoying. Digital effects can be applied more precisely and with immensely better quality on the desktop PC with editing software.

■ **Titling.** Titling is the process of overlaying text onto video footage. Essentially, it is another digital effect that, again, is better handled on the desktop PC. Because virtually all DV footage has to pass through the computer anyway, even if only to email short clips to someone, you might as well apply titling on the desktop PC. Doing it on the camcorder will only take longer and look worse.

■ **Software Bundle.** Most DV camcorders don't come with much of a software bundle. If yours does, you're probably wasting money. The titles that are included are usually for editing and managing still photos. The reason for this is that DV editing is more complex, and it's difficult to judge the expertise level of the user based on the class of camcorder. You wouldn't want to bundle Adobe's Premiere editing title with a low-end Canon—the software costs as much as the camera. Because of cost and support issues, most vendors take a hands-off approach to software. So don't feel that the manufacturer is skimping by not packing in the same slew of applications you're used to seeing with still cameras or scanners.

■ **Think, Then Buy.** Many consumers get so excited about the prospect of at last having a digital camcorder that they give no serious consideration to what they plan on using it for. Is it for recording the baby's milestones growing up? For capturing footage suitable for incorporating into a business commercial or presentation? Are you a perfectionist or just looking to grab the essentials? Now that you know the necessary buying points of camcorders, consider how those features interplay with your own video needs.

New camcorder buyers are prone to two mistakes: buying too much and buying too little. The first group either wants to be prepared for any future DV desire and, therefore, needs every possible feature, and the second group only visualizes the present application. The first buyer might want 1.3-megapixel still photo capabilities even though he owns a 4-megapixel still camera. Why? Well, it might come in handy someday. On the other hand, a newlywed might buy a low-end camera thinking he had no need at all for still photos. Nine months later, he realizes that the ability to take snapshots of a newly born baby for quick emailing to relatives might come in rather handy.

Think about what you want to do with a camcorder today, then consider what you might want to do with it one to two years from now. Beyond two years, the technology and your lifestyle are likely to have changed considerably, so it makes no sense to plan for such far-flung possibilities. But if you're starting a new business now, it's very plausible that you might want to prepare video-based sales presentations to distribute on CD in a year or so. Quality will be key, so you would be wise to target at least a midlevel camera. Buy with the near future in mind and you'll make the best decisions. LS

by William Van Winkle

Digital Video Superstars

The Top 10 Digital Camcorders

You've learned the specs and understand the fundamentals of digital video shooting. Now, it's time to roll the dice and pick a camera to be your companion and help record those fleeting and creative moments.

Often, picking a DV camcorder can be something of a gamble. These are intricate, relatively expensive devices, and a quick look at them in the store may not reveal everything you need to know.

To give you a better idea of today's camcorder playing field, we've assembled 10 of today's finest models that address all price points within the consumer budget. Any of these models would keep a beginning shooter happily occupied for weeks, but more experienced users—or those who aspire to become more proficient with DV—should pay close attention to the fine details. As with all things in computing, you do get what you pay for, and an extra $100 or $200 out of pocket today is liable to pay rich dividends in your final video projects.

Low End: Up To $750

Canon ZR40: $599. In figuring out what features to include and what to omit from its entry-level DV camera, Canon made some very wise choices. First off, Canon knew that low-end buyers would value wide optical versatility over professional-level image clarity. This is why the ZR40 uses a very impressive 18X optical zoom lens (360X digital) to pull in action from a block away. On the other hand, the ZR40 only features a 460,000-pixel CCD (charged-coupled device), but only 290,000 of these pixels are "effective," or actually contributing to the captured image, which is why we've observed the unit to be a bit weak in clarity, color depth, and low-light conditions.

However, Canon gave the unit a special night-shooting mode. Unlike most night-vision systems, which rely on infrared, Canon drops the camera's frame rate as far as necessary to achieve acceptable illumination, theoretically all the way down to 0.5 lux (one lux of light is the amount of light from a candle measured from 1 meter away). Without night vision, the ZR40 is rated at 100 lux. This works fine for capturing still objects, but rapid motion will have a slow strobe-like appearance. On the other hand, whereas most night-vision systems resort to black and white or green and white, the ZR40's system retains full color.

Canon's menu system is clearer than most, and navigation is made easy thanks to the use of the volume wheel serving as a scroll wheel. Press in the wheel, and it serves the same function as a click. (Using the zoom lever instead of the volume wheel might have been more intuitive.)

The 2.5-inch swivel LCD (liquid-crystal display) screen is decent but tends to get overwhelmed by outdoor lighting, which is why Canon still uses a color LCD viewfinder. Interestingly, in an effort to save space, Canon designed the ZR40 to load tapes from the bottom, which is fine—until you need to dismount the camera from a tripod.

The ZR40 features only a few manual image controls, but the good news is that the camera's programmed AE (autoexposure) mode works quite well. Side-mounted control buttons are large and fairly intuitive. As with most medium-sized camcorders, the 1-pound, 2.5-ounce ZR40 fits comfortably in the hand for prolonged shooting, and the main control buttons are easy to reach. Speaking of which, the ZR40 also features an LP (long play) shooting mode, which uses higher image compression to achieve 1.5X shooting times.

What you won't find on the ZR40 are the MultiMediaCard (MMC)/Secure Digital (SD) slot for capturing still shots, a USB (Universal Serial Bus) port for transferring these stills, and a progressive scan shooting mode. (The ZR40 saves stills to the MiniDV tape.) Fortunately, for only an extra $100, you can find all of these features in Canon's upgraded unit, the ZR45MC. Take one more step to the ZR50MC ($799) and you can also add an accessory hot shoe.

The ZR40's image stabilization is good and there is an analog-in jack for converting old videotapes to DV. For a starter DV camera, the ZR40 packs in a ton of good value.

JVC GR-DVL120U: $599.95. When you're ready for a pleasant surprise, wrap your hand around Sharp's latest entry-level DV camcorder, the DVL120U. This unit boasts a 680,000-pixel CCD, delivering 520 lines of resolution, not bad for a camera that carries a street price bottoming out at $400. Also noteworthy is the 120U's 16X optical zoom (700X

digital). The lens is f/1.8 and gets an extra boost from JVC's Super Hi-Band processor. The two attributes make for an exceptionally bright image in an affordable camera.

Still photos at 640 x 480 resolution are recorded to tape, not flash memory, but JVC throws in three New Soft Presto! titles—Presto! PhotoAlbum, Presto! Mr. Photo, and Presto! Image Folio—to help owners do more with their still shots. Although not abundantly useful, one potentially handy feature is the ability to capture still images and save them straight to a connected PC, bypassing the tape altogether. For those only looking to email VGA-size snapshots to friends and family, the 120U is a great way to avoid shelling out an extra $150 for a low-end digital camera.

The 2.5-inch LCD swivels 270 degrees and is backed by a sensibly low-cost black-and-white viewfinder. Manual focus, exposure, and white balance are offered, as well, and an iris lock feature can be very useful when panning across different lighting conditions. There are S-video and RCA connectors for plugging straight into a television. Those enamored of silly still photo layouts, audio-dubbing capabilities, and plenty of digital effect doodads will not go away disappointed.

Sound from the 120U's integrated stereo mic is decent, digital stabilization is fair, and the AE modes deliver great results until you reach low-light conditions. There is no lamp on the 120U, but that's nothing new at the entry level. The only caveat with this model is that the integrated IEEE (Institute of Electrical and Electronic Engineers) 1394 port is of the 4-wire variety and standard desktop IEEE 1394 connectors are 6-wire. You'll need the proper cable to get from the camera to the computer, but JVC does not include it in the package. Apart from that, the 1.4-pound 120U is a fabulous camera that should satisfy any DV newbie. The 120U gets our vote for Editor's Pick thanks to its combination of low price, high resolution, and robust picture quality.

Sharp VL-NZ50/55U: $599. Available in silver (NZ50U) or black (NZ55U), this Sharp camera kicks butt. At first, you may be put off by the 10X optical zoom (300X digital), which seems paltry compared to the Canon and JVC models. Realistically, though, Sharp knows that low-end camcorder consumers are usually on the go, recording friends and family, not doing studio work with a tripod. Because heavy-duty magnification all but requires a tripod to avoid "Blair Witch"-like jittering (even after digital stabilization), extreme optical zoom may not be essential in a camera with a street price of about $450. Sharp chose to save money on the zoom and put the money into other, probably more useful, features.

Canon ZR40

The first thing you'll notice about the NZ50/55U is its swivel body design, similar to several of Nikon's popular CoolPix digital cameras. This affords the same 270-degree swivel advantages of most horizontal camcorder models, but now the LCD is built into camera body, which can mean better protection against damage (assuming you carry the camera in a protective case when it's not in use). There is no viewfinder, but you won't miss it because Sharp's spacious 3-inch LCD only reflects 1% of the ambient light, meaning there is far less glare and loss of visibility in outdoor conditions.

Although not as small as an upright camcorder, the NZ50/55U measures only 5 9/16 x 3 11/32 x 2 5/16 inches and weighs a scant 1.01 pounds when stripped of everything that isn't bolted to the camera body. The most serious problem with the design is where to put your fingers. Your thumb has easy, comfortable access to all of the main controls, and you can crane your index finger back to rest on the still photo release button, but that still leaves your middle finger flopping around in front of the lens. Coping with this leaves the camera feeling slightly off-balance for one-handed work. When using both hands, placing your left thumb over the gamma/brightness and fade buttons, the camera feels more comfortable to hold.

The gamma/brightness control does an excellent job of keeping images clear and colors vibrant without washing out white regions as many entry-level cameras do. Moreover, the NZ50/55U has some of the best low-light sensitivity (without resorting to shutter speed gimmicks) of any low-end camera we've seen. Sharp's digital stabilization could use a little refinement, but we like the thoughtful extras, such as the integrated speaker for audio playback and an on-screen grid for helping to track and frame subjects.

The NZ50/55U dispenses with still image capture to flash media, but in nearly all other respects, this is a great starter camcorder. The NZ50/55U is a tough unit with exceptional picture quality for its price, and we don't hesitate to recommend it.

Sharp VL-NZ55U

Sony DCR-TRV340: $699. Sony is generally regarded as the king of digital camcorders, and even though the company's forte is ruling the high end of the market, the TRV340 proves that Sony is able to excel in any market segment it likes. Of course, Sony, the company that brought us the Betamax ages ago, is prone to trying to bend the world to its own

proprietary technologies, and this camera offers two prime examples.

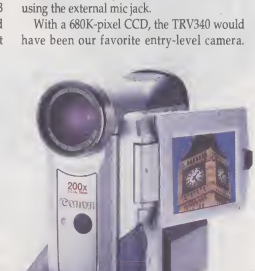
First, the TRV340 is a Digital8 camcorder, not MiniDV. Digital8 has the advantage of being backward-compatible with Hi8 and 8mm analog tape formats and can actually write in Digital8 format onto these older tapes, albeit at double-speed, thus halving the tape's run time. The downside is that only Sony supports Digital8. The same situation holds true with the TRV340's flash media format, Memory Stick. Sure, it's great to see flash card support in an entry-level unit (8MB included), but a more broadly supported card format would have done everyone—except Sony—a big favor.

The detractions aside, virtually everything else about this camera is awesome. The CCD only has 460,000 pixels, but Sony must use a superior grade sensor because images are consistently bright and well-saturated, typical of what you might find in a midrange unit. The optical zoom extends up to 25X (700X digital), and the digital stabilization system is good, although only a tripod could hope to cope with 25X. Sony's low-light sensitivity is remarkable, even without the infrared NightShot system, which now records in color rather than black and white. If you allow for slower shutter speeds, the TRV340 maintains satisfying image quality all the way down to 4 lux.

On top of the IEEE 1394, S-video, and mini A/V ports, the TRV340 features a USB 1.1 connector, which is both a blessing and a frustration. A quick look at the TRV340's sales sheet tells you that you can transfer 640 x 480 resolution stills, live audio-enabled Web cam footage, and recorded video via USB, making it sound like the ideal solution for anyone lacking a IEEE 1394 port on his or her PC. However, you can't transfer DV footage via USB (Universal Serial Bus). The bandwidth required would have you sitting by your camcorder all night. Instead, the TRV340 features a highly compressed MPEG (Moving Picture Experts Group) movie mode. MPEG clips at 160 x 112 resolution can be saved to the Memory Stick (8MB included), or 320 x 240 clips can record to the tape. Only MPEG movies can transfer over the USB line.

As with all Sony screens, the 2.5-inch LCD displays beautifully and shows up well outdoors. The camera is very comfortable to hold and operate, and we really like that Sony put a set of basic control buttons on top of the camera and a separate set for editing and navigation in the LCD bay. The black-and-white viewfinder is fine but unnecessary, there is an external speaker to complement the stereo microphone, and the whole camera weighs 2 pounds, 2 ounces with the included battery. Sony even throws in a hot shoe. One annoying technical glitch, though, is that Sony's mic is so good that it usually picks up the camcorder's recording mechanism, so consider using the external mic jack.

With a 680K-pixel CCD, the TRV340 would have been our favorite entry-level camera.



Canon Elura 40MC

But given the lower resolution and high price, we can't decide if this is an over-inflated starter camera or an under-powered midrange. If you don't mind the proprietary Sony technology and 480K-pixel sensor, though, the TRV340 is dynamite.

Midrange: $750 To $1,000

Canon Elura 40MC: $999. As an incremental update to the older Elura 10 and 20MC models, the 40MC packs in several design enhancements without jumping into the high-end price range, but it's not a revolution in functionality. The design measures a scant 3.4 x 1.9 x 4.2 inches and weighs a mere 13 3/8 ounces, making it very convenient to slip into a jacket pocket. The 680,000-pixel CCD provides bright, crisp details, and the camera's automatic modes do an admirable job of coping with difficult lighting situations.

Whereas the older Elura 10 only offered standard and progressive shooting, the 40MC covers DV, motion JPEG movies for emailing, and 1,024 x 768 resolution still capture to either a 6-second swath of tape or to the MMC/SD card (8MB SD included). One of our biggest gripes with the older Eluras was that one's index finger was continually thumping into the top-mounted microphone. Now, the 40MC slides the integrated mic back even further, atop the color viewfinder, so that it rests right next to your eye. This might yield slightly better sound quality but could be a problem if you have long hair that dangles in front of your face. Another leftover problem is the positioning of the Elura's still photo button and zoom lever, both of which are positioned just past the fourth fingertip. Guitarists may find such dexterity easy to manage; we had a harder time.

Indoors and under low light, we were quite pleased with the 40MC's sensitivity, particularly in its ability to capture detail in shadows. Low-light images often appear grainy and slightly blue-shifted, but not intolerably so. Under standard lighting conditions, the 40MC's image quality is superb, demonstrating Canon's expertise in professional-grade digital camcorders. The camera's eight AE modes all perform well, and there is full manual control over focus, shutter, exposure, and white balance.

The 2-inch rotating LCD screen is bright and clear. The camera includes S-video and A/V jacks for analog functions, both of which are now integrated rather than an add-on via a docking module. Menus are a snap to navigate, and the digital effects options don't clutter up the interface. The lens offers 10X optical zoom and either 40X digital (which looks decent) or 200X digital (which does not).

Plenty of other good surprises are waiting, too. The 40MC features full-color infrared night vision, the ability to stitch still shots into a 360-degree panorama, and output capability to Canon's CP-10 Card Photo Printer. Unfortunately, there is no hot shoe, but the 40MC does have an external mic jack. The 40MC deserves our Editor's Pick thanks to its terrific image quality and

plethora of worthwhile features all jammed into a tidy, tiny design.

Panasonic PV-DV402: $899. The low- to midlevel market is Panasonic's forte, and the DV402 falls somewhere between these two groups. A sub-$650 street price should really put the DV402 in top contention for the low-end category. The camera's 680,000-pixel CCD delivers fantastic image quality, and stills are interpolated to 1.3 megapixels for storage to the MMC/SD card (8MB SD included). Normally, we're not fans of interpolation, but Panasonic's implementation does a formidable job, and even the digital zoom (700X max) appears acceptable up to a reasonable point.

The DV402 feels more like an entry-level camcorder in other ways, too. The optical zoom is only 10X and the USB connection is touted as being for "teleconferencing," but that's really just a cover-up for plain old Web camming. The Movie Messenger system lets users transfer MPEG-4 format audio/video clips back to the PC for emailing or arranging into presentations.

Where the DV402 shows its midrange colors is with features such as Dual Digital Electronic Image Stabilization, which not only steadies the frame while you record but also during playback. The 3.5-inch LCD dominates this low-profile, horizontal design. The larger screen means heavier battery drain, so inclusion of a black-and-white viewfinder was a good idea.

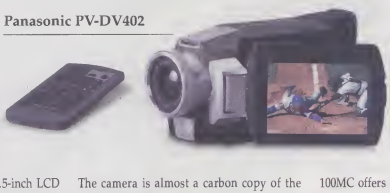
One place where Panasonic has not stayed up to date, however, is the infrared night vision mode. Whereas most competitors have gone to full color infrared, the DV402 still only offers monochromatic shooting in black, blue, or green and white. On the other hand, the amazing clarity of Panasonic's "MagicVu" IR system on objects only a few feet away is far superior to nearly all other camcorders we've seen. The camera also offers modified shutter speeds for very low-light shooting.

Although the DV402 does support 1394, USB, S-video, A/V, and RS-232C output, it surprisingly lacks a hot shoe. This is doubly disturbing because the integrated microphone, typical of a low-end camera, points up at the sky rather than at the subject. The reason for this, though, is that a lamp takes up the mic's usual position. Given the scarcity of this sorely needed feature among DV cameras, we're willing to overlook the mic positioning and recommend using an external. However, Panasonic turned the integrated mic into a "Zoom Microphone," meaning that the sensitivity of the mic changes in accord with the optical zoom function. So as you zoom in on action farther away, the mic becomes more sensitive. For those who want to be in the picture, a remote control is included, and the 1-pound, 4.4-ounce weight is reasonable.

The DV402 isn't an obvious knockout, but we've been very satisfied with Panasonic's quality and durability in the past, and this camera continues that tradition.

If you like the DV402 design, but just wish it were smaller, try Panasonic's new ultra-compact Panasonic PV-DC252 ($999). Only 1.04 pounds, the DC252 is a horizontal design made almost small enough to be a vertical.

Panasonic PV-DV402



The camera is almost a carbon copy of the DV402 in functionality.

Sharp VL-NZ150U/155U: $799. If you liked Sharp's NZ50U/55U from the entry-level category but wanted just a bit more power, don't miss this upgraded model. The 150U/155U offers the same core specs and features. The biggest difference between the models is that the 150U/155U features a USB port and the ability to store VGA resolution images. Why only VGA? Because the 150U/155U still only offers a 460,000-pixel CCD, which is fine in the entry-level category but somewhat out of place here. Video footage looks great, but the still images are only so-so, which might make one wonder if the $200 upgrade from the NZ50/55U is really worth it.

Sharp includes a 16MB SD card, which is more generous than most, and a remote control. Also notable is the inclusion of a standard lithium-ion battery and a long-life battery, which will add a bit more weight and bulk to the camera. A lens hood and wrist strap are bundled, as well. The 150U/155U really belongs in the entry-level group. If you can find the camera for $650 or less on the street, consider it a good deal for ambitious beginners. But without night vision, better manual controls, and other common midrange features, we can't recommend this for serious intermediate users.

High End: $1,000 & Up

Canon Optura 100MC: $1,499.99. Canon's finest single-CCD camcorder has several distinctions that make it a standout in the camcorder crowd. For starters, the unit is able to capture 1.33 megapixel still images (at 1,280 x 1,024) to MMC/SD media. Although the still image write times are fairly long and the color isn't as good as a conventional digital camera, the Optura's stills are sharper and richer than most, aided in part by the automatic pop-up flash. (The flash does not double as a video lamp, however.) The progressive scan enabled 100MC only offers 10X optical zoom (200X digital), but what makes the zoom exceptional is that it is optical rather than digital. In general, the 100MC offers some of the best image quality you'll find in a sub-$2,000 camcorder.

Naturally, the Optura 100MC features a hot shoe and standard microphone jack. Seven AE modes are offered, and there are manual overrides for exposure, focus, shutter, and white balance. A fair number of digital effects are supported, as is mixing in elements from the MMC card, but these are disposable features better handled on the desktop.

The 100MC sports a 2.5-inch LCD screen in addition to a 0.55-inch color LCD viewfinder. As usual, Canon's screen doesn't excel in bright light, but it is one of the first vertically oriented camcorders to offer a tilting screen, which helps mitigate glare problems. Our biggest problem with the 100MC is its zoom lever, a problem found with all Canon uprights. Canon tends to design for relatively small hands, and we found the zoom, located below the fourth finger, difficult to accurately manipulate. However, this problem is mitigated by the fact that the 100MC has a fairly

slow zoom speed, and the hand strap swivels to give you greater range of support in holding the unit. So although we don't like the zoom design, the overall effect isn't as bad as in the Elura series.

Canon bundles an 8MB MMC card, which is nothing to write home about, but the inclusion of a lens hood, S-video cable, and remote control are welcome additions. The 100MC abounds with a lot of other small perks, but if you buy it, buy for the image quality.

JVC GR-DVP7U

JVC GR-DVP7U: $1,499.95. Often found for less than $1,200 and without question one of the most compact camcorders on the market, this 0.75-pound wonder jams an amazing number of features into its Lilliputian chassis. Small size thankfully does not mean small CCD because JVC uses a 1.02 megapixel progressive scan sensor that does worlds to improve the low-light deficiencies found in the DVP3U. The f1.8, 10X optical zoom (200X digital) yields spectacular image quality in daylight conditions, delivering the best color results of any camera in this roundup. Even side-by-side black-and-white objects, always a hard test for camcorders, retained full detail.

Still photos can be saved to the SD memory card (8MB included) in 640 x 480, 1,024 x 768, and 1,280 x 960 resolutions. Twelve MP3 sound effects come bundled on the SD card for dubbing into your footage, but the novelty of adding laugh tracks and screams to your video wears off surprisingly quickly. There are a lot of digital effects, and the menu system is simple to navigate.

Although the DVP7U uses side-entry tape access, SD cards load via a plastic door on the camera's bottom, which could be a problem if mounted to a tripod. Similar to the Elura, JVC has dispensed with the docking adapter and now offers all S-video and other ports through integrated jacks.

One of the DVP7U's strongest assets is its control design. The Play/Pause/Record button sits in the middle of the dial underneath your thumb. Around this is a ring. Push the ring one way and you zoom in all the way to 10X; pull the other way and you zoom out. The effect is smooth and intuitive, especially for those of us who have trouble coordinating more than one finger at a time.

The DVP7U includes plenty of unexpected bonuses, such as a function to cut down on wind noise and an animation feature that lets users capture just a few frames of a still object at a time so to produce stop-motion photography, the process used in Claymation. The camera also includes a hot shoe, remote control, standard manual controls, Web cam functionality across the USB bus, and the quality of the 2-inch LCD is decent. Given a choice, we'd take home the DVP7U over the Optura 100MC for its superior imaging over Canon's better image stabilization, but both are exceptional machines. In this case, awarding the Editor's Pick to JVC necessitated a photo finish.

Sony DCR-IP7BT: $1,699. As Microsoft has proved several times, it often takes several product generations for a vendor to get a new product type right. Sony is close on the IP7BT, but there are still a few holes in the design.

The IP7BT is the smallest and lightest camera on the market, weighing a feathery 12 ounces with battery and measuring only 1 7/8 x 4 x 3 1/8 inches. This is made possible by using Sony's own MICROMV tape format. MICROMV tapes are 70% smaller than MiniDV and record as much as 60 minutes of digital video. Built-in memory lets users quickly scan through tapes by way of thumbnail scene images, much as DVDs do. Also like DVD video, MICROMV uses MPEG-2 format instead of DV for encoding footage. This has the advantage of transferring roughly twice as fast back to the PC. The downsides are that MPEG-2 is not a standard video-editing format, so the camera is compatible with Sony's bundled Movieshaker software and practically nothing else. Because MPEG-2 is so much more compressed than DV, there is a visible detraction from overall video quality.

Apart from the form factor, the IP7BT's big draw is its use of Bluetooth technology. This lets the camera transfer data with other Bluetooth-enabled devices, although right now the only compatible device is Sony's bundled Bluetooth network adapter, which plugs into a standard phone jack. The camera can dial out and connect to the Internet to send stills and video clips, as well as actually browse the Web on the swiveling 2.5-inch LCD screen. Why anyone would want to surf the Web on a 2.5-inch screen within 30 feet of a phone jack is beyond us. Moreover, still images must be uploaded to Sony's ImageStation.com, and the online access is done through a subscription service with Sony.

Sony equips the IP7BT with its trademark Carl Zeiss lens (10X optical, 120X digital), so images are nice and crisp, but the lens is backed with only a 680,000-pixel CCD. In fact, stills are only recorded in 640 x 480 resolution. There is no hot shoe, and Sony makes the same mistake as earlier Elura models by positioning the integrated mic on top of the camera right where your index finger goes. There is no external mic input, and manual controls are quite limited.

That's a lot of bad news for a $1,700 camera. Sony's ability to innovate and drive the industry forward is obvious in this design, but the implementation is simply not where it needs to be yet.

■ **What Matters.** In the end, all the fancy features in the world make little difference compared to learning the fineries of DV shooting and becoming proficient at the editing process. Even a $20 disposable camera can take museum-class photographs when the correct hands wield it. The same holds true with camcorders.

If you're new to DV camcorders, we strongly recommend beginning with a decent entry-level unit before shelling out for a midrange or advanced model. This is a fast-moving market, and there's no point in paying for features you don't yet need. Starting with the basics will help ensure that you become comfortable with DV technology so you grow to crave more power and don't feel overwhelmed by it. LS

by William Van Winkle

More Than Point & Shoot

What You Need To Know To Be A Great Cameraperson

Disneyland was fantastic. Your family had the time of their lives. The kids couldn't stop talking about it the whole flight back. You'll have to thank your brother for buying you that video camera just before your trip. You can't wait to get home. Everybody's dying to see the video.

You get home. You watch the video. Now you're dying.

Mickey looks kind of orange. You cut off his ears. Pluto looks like a silhouette, or at least you think he does. It's hard to tell. You only taped two seconds of him. Five minutes later your spouse is yelling at you to shut it off. The whole family is getting nauseous from the motion of the video.

Way to go. You went to the "happiest place on Earth" and brought back the worst video on Earth.

Although it seems the tape has thousands of problems, you really only made one mistake. You didn't study the camera before going on vacation. Think like Buzz Lightyear. Buzz learns every button and possible scenario before he blasts off. You pulled a Goofy. Buying an expensive video camera doesn't make you a great cameraperson. Practice does.

■ **All Those Buttons & Options.** Grab a blank tape, press that red Record button, and start playing with every single feature on the camera. Announce each feature as you select: "I just increased the shutter speed to 100." When you watch the tape in playback you'll be able to see how each effect changes the quality and look of the video.

Teach yourself everything so that you know what to use, when to use it, and what never to use. You and the rest of the family will be much happier if you test the camera out first rather than during next year's trip to Dollywood.

■ **The Tripod—Caffeine's Antidote.** You may have spent $1,200 for a video camera with image stabilization, but it does you no good if you just had four cups of 50-cent coffee. Shaky video makes people sick when they look at it. The first concern of all camera work is to get a steady shot. Audiences demand it.

You need to buy and use a tripod. No camera technology or steady hand can beat it. A cheap one will be fine, but if you want to use it for panning (moving the camera horizontally to record a moving subject), you'll have to spend at least $100 to get a tripod with fluid horizontal and vertical movement that can lock in any position. For videographers who need to constantly move, try using a one-legged tripod, or monopod.

■ **Compose Your Shot.** When you look through the viewfinder, mentally divide up the image vertically and horizontally into thirds like a tic-tac-toe pattern. The four intersection points that result from this criss-cross pattern become the optimal points to capture subjects within your frame, as shown in Figure 1.

This framing technique is known as the **rule of thirds**. Centering subjects is unimaginative (especially in repetition), and if they're on the edges of the frame, you'll have a lot of nothing in the center. Use actual lines of your environment in your image, such as the horizon, streets, and telephone poles, to give a sense of framing and composition.

If you're shooting an interview, place the person on either the leftmost or rightmost imaginary vertical line. Frame the subject from the shoulders or chest up. Leave a little space above the person's head. If the person's head just meets the top of the frame in the viewfinder, it will probably be cut off when viewed on a television.

As the interviewer, stand on either side of the camera. (Change sides for different interviews.) Remind your subject to look at you and not the camera.

Do all of this before you press the Record button. Nobody wants to watch the process of you setting up a shot. You wouldn't do it if you were taking a still photo, so don't do it with video.

■ **More Pictures Equal Better Story.** Say you're shooting a video of someone flying a kite. A single shot will show that the person is flying a kite, but it doesn't tell a story. Take multiple shots to tell the story of the day he flew the kite, much like the ones shown in Figure 2:

1. A shot of someone helping the kite flyer get the kite off the ground.
2. Take a shot of the whole scene, capturing both the person and the kite in the same frame. This is known as a **wide shot** or an establishing shot.
3. A zoomed shot (focus in on the object as close as you can) of the kite.
4. A shot of just the person with the string in his hand.
5. A close up shot of his hands operating the kite.
6. Shots of other people watching him fly the kite.
7. A shot of the kite crashing.

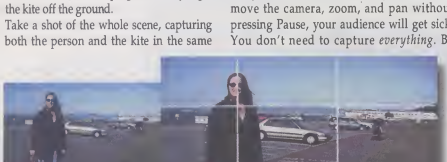


Figure 1. A centered shot makes for a boring picture. Compose shots by setting key elements along an imaginary tic-tac-toe pattern.

These are all **steady shots**, shots where you frame the action and keep the camera still. They don't require fancy camera movements, such as moving zooms or pans. What they require is the camera operator to think about how best to cover the event. It's something to think about before you even arrive at the location. Ask yourself, "What shots do I want to get?"

When shooting multiple shots of an individual, such as the kite flyer, shoot from different angles and distances. Among these pictures, shoot a close-up shot, a shot from behind him, a **three-quarter shot** (a range halfway between a profile and a shot right in front of the subject) from the right, and a profile from the left. Such varied shooting will make cuts look less obvious..Shots of other people watching the kite and a zoomed-in shot of the kite may be used as cutaway shots. **Cutaway shots** are used to show a passage of time by removing unnecessary action, such as three hours of kite flying.

■ **Shoot The Action, Don't Create It.** Although your eye doesn't need a Pause button, your video camera does. If you constantly move the camera, zoom, and pan without pressing Pause, your audience will get sick. You don't need to capture *everything*. Be deliberate about your shots and capture the action. Don't create it with unnecessary camera movements. The only time you should be constantly moving the camera is if you're capturing a sporting event. In those cases, the best rule to follow is to keep the ball in the shot.

■ **The Golden Rule.** Hold every shot for at least 10 seconds. Count to 10 if you have to, but do it. Ten seconds may feel like an eternity, but remember, a video camera is not a still camera. A single shot on video needs more than just a quick image capture for it to be usable when you go to edit.

■ **To Autofocus Or Not To Autofocus.** If you're shooting in well-lit areas where action is constantly changing, autofocus is a good choice. In almost all other situations, you'll want to use manual focus. That's because autofocus can be easily fooled.

In low or severe lighting conditions, autofocus can be slow to respond as it desperately seeks your subject. The camera will always focus on the object centered in the foreground even if your subject isn't there. So shooting through a chain-linked fence will offer a crystal clear view of the immovable fence, while the action in the background will appear as a blur.

For events where the focus is fixed, such as using a tripod to record your daughter in the school play, use manual focus. This will prevent the focus from changing if someone accidentally walks in front of the camera. To get the sharpest picture with manual focus, zoom all the way in on your subject, focus on the minutest detail, and then zoom out. Assuming you have a good zoom lens, this should keep your subject in focus at all zoom levels. To see if your zoom is up to snuff, try this test and make sure your focus doesn't change when you zoom out.

■ **Produce Effects With The Zoom.** Your camera's zoom function is best used to set up shots. Moving the zoom all the way out gives you a wide-angle shot. This setting is best for shooting action or to make a small space look larger. Push the zoom all the way in for a telephoto shot. The **telephoto shot** is most often used to bring distant, unreachable elements closer. It can also be used for dramatic composition.

Most novice camerapeople will be tempted to zoom during shots. Resist the temptation. If you have to use it, have a beginning and end point. For example, shoot a wide-angle shot of a condemned building and then push in to show the "Keep Out" sign. The zoom runs at different speeds depending on how hard you press its button. Practice keeping the movement of the zoom fluid and steady. The time of the zoom movement should be no longer than four seconds. Remember to hold the shot on either end for at least 10 seconds.

■ **Depth Of Field.** DOF (depth of field) is the distance behind and in front of the subject (that you are focusing on) that remains in focus. If everything is in focus, then the DOF is wide. If objects one foot behind your subject are out of focus, then the DOF is limited. Depth of field increases as a function of focal distance (macro to infinity), lens focal length (telephoto to wide angle), and lens opening (large for dim room light to small for bright sunlight).

If you have a scene with a limited DOF, you can switch focus from one subject to another to direct the viewer's attention to different objects within the same frame. It's a technique known as a rack focus, shown in Figure 3.

To do it, first turn off autofocus. Place one subject in the background and another in the foreground. Focus on the subject in the foreground. Once focused, put your hand in the 12 o'clock position on the focus ring. Now, keeping your hand fixed on the focus ring, twist it so you're focusing on the subject in the background. When it comes time to focus on the foreground, just quickly twist your hand back to the 12 o'clock position.

■ When Should You Move The Camera? If you want to shoot everyone at a party, walk up to each person, frame them, and press Record. When you're done, press Pause, walk to the next person, and repeat. Moving the camera around haphazardly to get everyone in the shot will make your audience ill. Pans, similar to zooms during a shot, should only be done to make a point. Have a beginning and ending point in mind.

For example, start with a still shot of an exercise bike and then pan up to the person pedaling. A pan should start slow, then speed up, and then slow down again when it reaches its destination. You can use this technique for zooms, too. If you have a tripod with a fluid swivel, use it. Remember to hold the shot for at least 10 seconds at each end and then make the pan no longer than four seconds.

■ Talk. The Camera Picks Up Sound. Shooting a video isn't all about pictures; it's also about sound. You want to pick up sound from your subject. That microphone sitting on top of the camera is not always the ideal choice. If your subject is 30 feet away, you're going to pick up all the sound between you and him, plus the sound to your left, right, and behind you. If you're using your camera to shoot interviews, invest in a lavaliere or stick microphone. If you don't have a mic, there are some ways you can compensate.

Place the camera as close to the subject as you possibly can. If you can't find a quiet space, turn your back to the noise. Plug in a pair of headphones to the camera's headphone jack and listen to your subject. If there is consistent background noise, such as the sound of the ocean or air conditioner, record five minutes of just that noise alone. This is known as ambient sound, and the purpose of having it is to maintain sound consistency for your final piece. If you shoot most of your interviews with that sound in the background and a couple of them don't have it, then you can mix in a little of the ambient sound from the location of the other interviews. Making your interviews sound uniform or at least fade in and out uniformly will sound more pleasing.

And remember, as the camera operator, you're not in the shot. So keep quiet; you really don't need a disembodied voice on your video.

Figure 2. Don't just show a kite going into the sky. Tell the story of the kite flyer's day at the park by taking shots at multiple angles and distances, as we did in this example.

■ You Can't Shoot A Picture You Can't See. Poor lighting is a result of extreme contrast issues. The worst and most common is backlighting. If the light source is behind your subject, your subject will lose definition, such as facial features. In the worst case, your subject will look like a silhouette. It happens all the time because many backgrounds, such as water and snow, reflect light.

First, try to avoid backlighting. Make sure that the sun is at your back, not your subject's. But sometimes you can't avoid backlighting. It's bright wherever you go. Luckily, your camera has a compensation for such a problem. It's a button that's appropriately named "Backlight."

Pressing the Backlight button opens up the aperture to let more light in, as shown in Figure 4. It causes the rest of the image to be overexposed, but it will hopefully improve the exposure on the subject. Your viewfinder should have an indicator to let you know that backlight is on. When you move out of the poorly lit situation, remember to press the Backlight button again to turn the setting off.

Extremely bright sunlight can cause your camera to go in and out of focus. Some cameras have a neutral density filter and can fix the problem by cutting out a percentage of the light. This will also bring out colors, such as a bluer sky.

■ Videotaping Your Daughter In The School Play. This is another contrast nightmare for your video camera. Stage left is brightly lit while stage right is in the shadows. The scene ends, and now stage right is all lit up and stage left is in the dark. The auto exposure settings on your camera will have a hard time understanding the scene and will end up washing out the actors in the well-lit areas. It will appear as if the characters are exploding with light, causing colors to streak from them. It's a phenomenon known as blooming. It looks horrible and in some extreme cases it can damage your camera.

To avoid this problem, check your camera's AE (autoexposure) settings. A camera's AE function will automatically set a series of different variables (including aperture, focal length, shutter speed, and white balance) given a certain scenario, such as shooting sports, sunset, or outside at night. Check to see if your camera has an AE setting for the stage. Turning on the stage mode does the reverse of hitting the backlight button. It closes the aperture to let less light in. This will reduce the

Figure 3. With a short depth of field, you can use rack focus to change the subject of your frame. The picture on the left emphasizes the sculpture that is in the foreground (left), but a simple change of focus highlights the sculpture that is in the background (right).

blooming effect and let you see your daughter's performance as a sea turtle.

If you're shooting at night and there's no possibility of adding another light source, you can compensate by bringing up the gain. **Electronic gain** or "gain up" amplifies the image data created on the chip's sensors. Increasing the gain will bring out pictures that would normally not be seen. The downfall is that it increases *all* image information, even the noise, so the quality of the image will be considerably worse than if the scene had been well lit.

■ **Why Does My Wife Look Like A Smurf?** Unless you live inside of a mushroom, as a Smurf would, chances are you don't have a bluish tint. Odd colors in video are a result of poorly set white balances. A **white balance** is the control that normalizes the camera's color light sensitivity to match the current condition of white light.

Light communicates color. Light is measured in color temperatures, or Kelvin. Different color temperatures will cause objects to appear differently colored. Take a look at any impressionist painting. Monet's haystacks are the same, yet they all look different because they were painted to highlight different lighting conditions. Sunlight, incandescent, and fluorescent light all release different color temperatures and therefore emit a different tone of white light. To see the appropriate colors given the current lighting conditions, the camera's white balance must be set correctly. Most cameras have auto white balance that can read the light source and set the appropriate white balance.

But lighting situations are not always constant, and this can confuse a camera that's set to automatically set the white balance. For example, if you're in a room with a warm incandescent light and there's an open window letting cool outside light enter the room, the resulting video will have a blue cast. To avoid the Smurf effect, close the shades to eliminate the outdoor light. If the indoor lights aren't enough, turn them off, open the shades, and move the subject next to the window.

Depending on the quality of your camera, its built-in auto white balance may not be sufficient for your needs. If that's the case, you'll need to manually white balance the camera. With the camera's recording mode paused, point the camera at any white object, such as a piece of paper, and press the White Balance button. Your camera is now white balanced for the current environment. Repeat if you move to a new environment.

Figure 4. When a subject is heavily backlit, it appears as a silhouette (left). Pressing the Backlight button will bring out your subject's features but overexpose the rest of the shot (right).

■ **Catch The Action.** A video camera has a shutter speed, similar to that of film cameras, even though it doesn't have a mechanical shutter. Video images are captured on a charged chip. The length of time that chip is charged to capture the image determines the video camera's shutter speed.

The standard shutter speed on a video camera is 1/60 of a second. If you want to slow down or freeze-frame action, such as a sporting event, you'll want to move the shutter speed up higher. (To compare, most 35mm film cameras shoot at 1/60 of a second when a flash is used, which does not freeze fast-moving action, such as the players and ball during a basketball game.) When the video is slowed down or frozen, there will be little to no blur. Be careful. Set the shutter speed too high and you'll get a strobe effect. If shooting sports, check to see if your camera has an AE sports setting.

■ **Record The Computer Monitor.** Shooting an office scene with computers in the background can be a troublesome task. Monitors in the background can flicker or show scrolling bars.

To get a monitor to sit still and behave, you need the shutter speed on the camera to match the scan rate of the computer monitors. On the PC, check the Display Properties to see the screen refresh setting. The monitor will sit still when you change the camera's shutter speed to equal the PC's screen refresh rate. You could also switch the computer's screen refresh to match the shutter speed.

■ **Made To Be Broken.** These are just basic camera rules. Each one can be broken to create a desired effect. But to break a rule, you need to know what rule you're breaking, and why. Learn the rules so you can break them.

Watch more television. Watch TV with a critical cameraperson's eye. You'll see many of these rules in action and some being broken. How is the image composed? Where are the light sources? Look at all the images in a single TV news package. What shots did the cameraperson take to tell the story?

You won't realize many of your mistakes until you watch the tape. Go out and shoot and bring it home to watch. Conquer your problems now so that everyone can enjoy your production when you get back from Disney World. LS

by David Spark

All In The Family

How To Shoot A Family Gathering

Family gatherings are vaults of wonderful memories waiting to happen, and many families have a designated amateur videographer standing by, ready to capture those moments. But videotaping family gatherings involves more than grabbing a DV (digital video) camcorder and saying "cheese." If that's your approach, your family film will earn a big thumbs-down from your audience. But if you know a few simple techniques, you can make your family films look as if they were produced by Steven Spielberg rather than someone at your local public access channel.

■ **The Essentials.** You don't need a lot of equipment to record a family gathering. You will need a camcorder, of course, which we're assuming you already have or will have soon. You should also buy a handful of spare tapes. Michael Rubin, author of "The Little Digital Video Book" and a former employee of Lucasfilm Ltd.'s DroidWorks post-production department, recommends buying five-packs of tapes for your DV camcorder.

You won't be able to use your camera for long if it doesn't have a good battery. Double-check the battery shortly before the family event and always pack a fully charged spare. You can buy a bag to store your camera and tapes, but that's all the equipment you really need. For example, Rubin doesn't bring a tripod along to his family gatherings. "I'd rather be playing with my nephew" than hassle with a tripod, he says.

Steve Beal, author of "The Complete Idiot's Guide To Making Home Videos" and president of video post-production company Keyframe Post, also likes to keep the equipment list short and sweet. He says, "Tripods are almost useless for home video. You should participate in the family gathering, not get bogged down with details of shooting."

Some home videographers may be tempted to script out a family event ahead of time so they'll be prepared to shoot it according to a preconceived timeline. Events rarely unfold as planned, however, so it's better to let things happen naturally. Don't try to direct the action. You're not filming a documentary; you're recording memories for family and friends. You're also a guest, which means you should be enjoying the event rather than spending the entire time hiding behind a viewfinder.

■ **The Art Of Shooting.** Many home videographers are content to let the camera roll during the entire gathering, panning this way and that, recording whatever happens to be in front of them without any real purpose. This technique, or lack thereof, will result in a very long and very boring videotape. You can make your home movies much more interesting by using a few simple recording techniques that you can apply to any situation.

Rubin says the key is to capture a few shots that you know you'll need when it's time to edit your videotape. You should try to record about 20 minutes of video for most gatherings. If you record more than that, you won't be as likely to watch it later, and it'll also make for a rather large project if you decide to edit the tape later on. If you record less than that, you may not have enough footage to edit into a nice little story.

Be creative. You want a variety of shots and more than just shots of people. Rubin looks for shots that suggest beginnings or endings, such as someone walking into or out of the camera's frame. You may also want to include an establishing shot that relates to the theme of the gathering, such as an image of the Jack-O-Lantern on the porch at a Halloween party. The **establishing shot** provides a frame of reference for your audience because it shows where the action is taking place. You can also interview people and get close-ups of some of the action. By giving yourself a variety of shots, you'll be able to edit together shots that complement each other.

Rubin is particularly fond of reverse shots. A **reverse shot** is a second shot of a particular scene taken from a different vantage point. He'll record an event, such as a family picnic, from one side for several minutes, then move to the other side and record from that angle. Rubin says, "It gives me two shots of the same event from different angles, which allows me to intercut them and shorten them." It's a simple technique, but it gives the video a sophisticated look.

Stay steady. One thing you should avoid is panning and zooming from one scene to the next. If you do pan from one scene to the next while you're recording, you should remove that portion of video when you edit your tape. Users tend to get a little carried away with zooming. Beal says, "It's definitely one of the most overused and abused video effects." He thinks it's OK to use a slow zoom to establish a setting once in a while, but if you get carried away with the zoom button, the resulting video can make your viewers a little seasick when they watch the tape.

Shed light. Photographers fret about the lighting situation when using a still camera, but this issue isn't as important when using a DV camcorder. Today's camcorders can handle just about any lighting situation, including very low light conditions. Rubin is a firm believer in using an environment's natural light, even in low light, so he doesn't attach a light source to his DV camcorder. Beal also discourages using a clip-on light. He says, "Your footage ends up looking like a bad local newscast, with harsh shadows and overexposed subjects." It's best to use your camcorder's automatic exposure mode.

■ **On Location.** There are two schools of thought as to where you should position yourself when recording a family gathering. The first approach is the "wildlife photography" method, in which you stay out of the way, recording the action from the periphery of the event. People won't notice you recording them, so they'll behave naturally because you're not hovering around them.

Rubin generally likes to stay out of the way, although he will occasionally record one or two interviews during a family gathering. "It's not about people interacting with me and the camera," he says. "It's about the camera capturing the scene."

The second approach is to get up close and personal. Talk to people at the event, ask them questions, and have them tell you what they're thinking. Beal favors the second approach. "People are what make your videos interesting," he says.

Film focus. The nature of the scene will depend upon the event. Some family gatherings, such as birthdays or graduation receptions, focus upon a particular person. In other cases, such as family reunions and holiday parties, the focus is on the event itself. When one person is the focal point of the event, most of your time will be spent recording that person. But you'll also want to record the other people at the event, especially how they react to the guest of honor. For example, you may want to videotape a father beaming with pride as his daughter shows off her diploma at a graduation party or the look on Grandmother's face when the 4-year-old grandson rips open the present she bought for him.

When you're at a gathering where no one person is the center of attention, you should try to record everybody who was at the event. Rubin suggests recording people engaged in different activities, such as relatives visiting, mom and dad preparing food in the kitchen, or kids eating at the "kids' table."

They're adorable. Kids may not start out as the center of attention at a family gathering, but it's usually not long before they become so. Kids are cute and do funny things that can put a smile on the face of even the most curmudgeonly uncle.

You shouldn't videotape kids the same way you videotape adults, however. Many people tower over kids when recording them, but both Beal and Rubin say you have to get down to their level so your camcorder is positioned at their height. For small children, Beal likes to flip the LCD (liquid-crystal display) viewscreen of his camcorder around so the kids can see it. "It's amazing how long they'll stay front and center, tantalized with their images on-screen." Kids are especially prone to changing their behavior when they know they're being videotaped. So if you want to capture footage of a child in his or her natural habitat, it's best to record surreptitiously.

■ **Cutting Room Floor.** So, you've just returned from the family gathering with 20 minutes of raw footage, each second of which you're sure is pure cinematic gold. Yeah, right. Chances are there will be at least a few sections of video that didn't turn out as well as you'd thought. Maybe someone bumped you, maybe you left the camera on as you panned around the entire party, or maybe some of the video you shot is as boring as the flavorless mashed potatoes your aunt Sally brought to the picnic. If you have a PC and a video-editing program, you can really clean up your video footage without too much effort.

Pull it together. Before you dump the video into your PC, you should take a moment to organize. Number the tapes and write down some information about what's on each tape. If you don't take a moment to record this

Begin your video with a symbol of the family gathering's theme, such as fireworks for a Fourth of July party.

When recording children, arrange the camera so that you're shooting at the same level as the child.

information, you'll eventually end up with a stack of used "mystery" tapes, just like your VHS collection (where *is* that "Star Trek" episode No. 457).

The cut. OK, the raw video footage is loaded into your video-editing software. Now what? There are two ways you can cut down the 20 minutes of footage into something more watchable.

The first method is culling, which is simply a matter of ripping out the bad parts and leaving in the good parts. Go through the tape chronologically and delete any sections you don't like or didn't turn out well. This should take less than an hour to do, and in many cases less than half an hour. In the end, you'll have a shorter, cleaner video, presented in the same chronological order in which you shot it.

Culling is very different from editing. When you edit videotape, you'll cut the video into short, two- to five-second pieces, rearrange them, and then string them together to create a little story. You can turn 20 minutes of videotape into a three- or four-minute video in an afternoon. Rubin prefers short videos like this because they're much more watchable. He says, "There will be lots of material that doesn't go into it, but you'll watch it a lot and so will other people because it won't feel boring."

Roll film. All stories have a beginning, middle, and end, and your family video should include these elements as well. It's best to open your short film with a shot that's indicative of the theme or nature of the party, although you can use something else that suggests a beginning, such as relatives pulling into the driveway.

Next comes the main body of the video. You can combine your video clips in just about any order you like. Try to pair video clips with reverse shots, although you don't have to include a reverse shot for every scene. Each family gathering will probably have a couple of key highlights, such as blowing out the candles on the birthday cake. You'll probably want to save these important shots for later in the video, although they don't have to be at the very end. Finally, you should have a closing shot, something that suggests the end of the story, such as family members saying farewell to each other.

Show both sides of the story. A reverse shot is one technique you can use to add variety to your family videos.

Did you hear that? Once you've edited the video into a coherent (and beautiful) short film, it's time to add the audio. Most great films have a great soundtrack, and there's no reason why your video project shouldn't have one as well. Both Rubin and Beal like to add music to their video products. A three- to five-minute video is about the length of a typical song, so add a song that reflects the nature of the party, such as a Beach Boys tune for a beach party.

Rubin likes to add a narration audio track to some of his family videos. If you record an interview with a relative, you can take the audio from that interview and lay it over other scenes from the videotape. You won't see Grandma in the video, but you'll hear her talk about the gathering and her family as you watch scenes from the party, which is a nice effect.

Moving on. Some of the most popular effects used by home video editors are transitions, but be sure you don't get carried away with them. Too many transitions between scenes are a distraction. In most cases you really only should use two transitions: fade in at the beginning of the video and fade out at the end. You can also add some simple titles to your video, such as "Roger's Birthday" or "Family Christmas 2002."

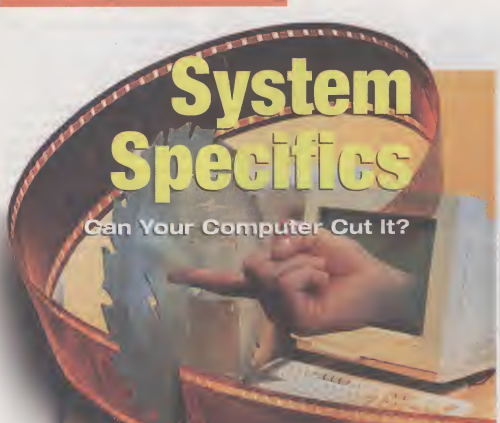
■ **That's A Wrap.** The techniques we've discussed are universal; they're tips from pros that you can apply to any videotaping situation. With a little practice and your nearly limitless creativity, you can create short family videos that are worthy of the Sundance Film Festival. LS

by Michael Sweet

Candid Camcorder

Don't even try to follow a script when videotaping a family gathering. It won't work, and you don't need one anyway. You do need to be prepared to capture a variety of shots as they happen. Here's a checklist of the kinds of shots to look for when recording a family gathering. Record a few of each, and editing your video will be a breeze.

Checklist	Example
Opening shot	Person running into frame, Jack-O-Lantern on Halloween, carolers at Christmas.
Main shots	Blowing out birthday candles, family members chatting.
Reverse shot	Scene or activity shot from a second angle.
Interview	Use interview of a guest to provide narration for other scenes.
Closing shot	Person leaving frame. Saying goodbyes.



System Specifics

Can Your Computer Cut It?

Video capture and editing on the PC can be an exhilarating experience, as the creative possibilities are almost limitless. Unfortunately, that same exhilaration factor can fade quickly if your computer struggles when handling video content. If it's been years since you've upgraded your system, you'll likely hit several roadblocks when delving into digital video.

Working with video can tax your computer's resources heavily, as it often involves a number of intensive tasks, and some of these tasks must run simultaneously. Just as digital pictures can be heavily modified, so can video. For example, you can take separate video clips and combine them into a full-length feature. Then, you can take that feature or the separate clips and modify them to your heart's content. You can add effects to spice things up with glitz and drama or use effects to add seamless transitions between clips. Animated, professional-looking text can boost the video's production value, as can music, sound effects, and narration (added to the audio track).

Modern video production software makes video capture and editing a snap, as long as your computer can handle the workload. The computing complexity involved with working with such content is usually high, meaning that low-end computers can struggle with multitasking video production duties. Luckily, computer components are less expensive nowadays, and you probably won't pay an arm and a leg just to upgrade your system to the point where it can handle video production. Let's look at what you'll need to get up to speed.

■ **Video Storage.** Considering that you need 3.6MB of hard drive space for each *second* of typical digital video, you'll need a big, beefy hard drive to store your work. Drive prices have fallen considerably in recent years, and drive speeds have increased alongside those price declines. If you plan to capture and edit video on a regular basis, consider buying a 40GB or larger hard drive. And because prices increase only slightly up to 80GB, buy as much as you can afford because you'll need the space later.

If you already have a large drive with enough free space to store video files, you still should consider purchasing a separate drive for your video tasks. Working on the same hard drive means that your video work will be hampered by system duties performed by your OS (operating system). Even if you partition your current drive so that you can separate your OS files from your future video files, you still won't receive the best performance possible from the drive. Typically, a second partition (such as the D: drive) is a bit slower than the drive's primary partition. Of course, you need the OS on the primary partition for optimum performance; therefore, you're left with a slower partition for your video work.

When purchasing a new drive, look for speed and size. EIDE (Enhanced Integrated Drive Electronics) drives come in several speeds, including 5,400rpm (revolutions per minute), 7,200rpm, and even 10,000rpm. The 7,200rpm drives are both fast and affordable, so if you can swing it, stick with this speed.

You'll also need to note which ATA (Advanced Technology Attachment) interface the drive uses. Many older motherboards support ATA/33, but newer drives often use the ATA/66 or ATA/100 interfaces. These drives might still work with an older motherboard, but if you want complete compatibility and the best performance, you'll need to purchase an expansion card or upgrade your motherboard.

Although EIDE drives can handle video with ease, another, more expensive option is SCSI (Small Computer System Interface). In certain configurations, SCSI drives can outperform EIDE drives, and SCSI devices also have the advantage of using only one IRQ (interrupt request line) to connect several devices. But as the price of EIDE drives continues to drop while their performance increases, it's difficult not to recommend EIDE drives for a quick, relatively cheap upgrade to handle video work.

■ **Data Processing.** Video capture and editing tasks won't put a tremendous strain on your

processor if it's fast enough. In general, 1GHz or faster processors should be able to handle any video duties you throw their way. This isn't to say that an Intel 450MHz Pentium II or an Intel 566MHz Celeron processor can't handle video production. In a properly configured system with enough RAM and a good video card, such processors could aptly handle many video tasks without a hitch. However, when you start multitasking and applying extremely resource-intensive effects, the processor could slow the process to a crawl. Even massive amounts of RAM and a top-of-the-line video card won't help because the work cycle will become bottlenecked at the processor. Therefore, a safe guideline for video work is a 1GHz processor or faster.

Like hard drives, processors continue to drop in price. You can find chips that are 1GHz (and even faster) for much less than $100, and compatible motherboards are priced similarly. And if you're a fan of tweaking your hardware, you know that many modern processors can be overclocked well beyond their advertised speeds.

For example, for about $140, you can purchase the Pentium 4 1.6A processor, which clocks in at (no surprise) 1.6GHz. With a little BIOS (Basic Input/Output System) tweaking, many of these chips can be set to run at 2.2GHz and higher. Although overclocking will automatically void the warranty on your chip, most modern chips can easily withstand the higher temperatures inherent in pushing them beyond their normal running speeds. Of course, with overclocking, you should make sure your computer case is adequately ventilated and that the processor is equipped with a proper heat sink and fan.

When shopping for a processor, keep in mind that different chips of the same clock speed may not perform exactly the same. For example, a 1GHz Celeron processor has 128KB of L2 cache, while a 1GHz Pentium III processor has twice that amount. Everyday office tasks won't reveal the difference, but you'll see a marked speed disparity (favoring the Pentium III) when delving into resource-intensive video work.

Similarly, Pentium processors and AMD Athlon processors don't always perform the same at comparable speeds or speed ratings. An Athlon XP 1800 can outperform a Pentium 4 1.6A, and it costs less. However, if you overclock the Pentium beyond 2GHz, the chips will be much closer performance-wise.

Video content consumes hard drive space like nobody's business, so you'll need a hefty drive such as this Seagate Barracuda (running at 7,200rpm [revolutions per minute]) to cope.

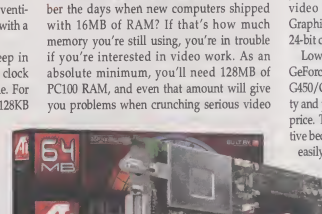
In the end, whether you choose an Intel or AMD chip, your processor will easily handle any video tasks you throw its way, as long as you aim for a 1GHz or faster chip. Of course, you'll also need a motherboard, and the type of chip you buy will limit your motherboard choices. And even though the motherboard choice isn't as crucial as other component choices, you should still make sure that it includes everything you want, including a sufficient number of ports (such as PCI [Peripheral Component Interconnect], USB [Universal Serial Bus], etc.).

■ **Don't Forget About Memory.** Remember the days when new computers shipped with 16MB of RAM? If that's how much memory you're still using, you're in trouble if you're interested in video work. As an absolute minimum, you'll need 128MB of PC100 RAM, and even that amount will give you problems when crunching serious video data. Like other hardware, RAM is cheaper than ever, so don't skimp when shopping. Aim for at least 256MB, and if you can afford it, get 512MB. At this level, you'll be able to multitask easily, which is essential when working with different parts of a video production.

Most PCs purchased in the last few years use PC100 or PC133 RAM. Many newer PCs use DDR (double-data-rate) or RDRAM (Rambus dynamic RAM) memory, each of which is much faster than PC100 or PC133. If you're already upgrading your processor, consider buying a chip that requires a motherboard that uses DDR or RDRAM. Both memory types are experiencing hefty price declines. In fact, DDR memory now costs only a few dollars more than PC133 RAM, and RDRAM is just a few bucks more than DDR. DDR and RDRAM are similar in performance, so base your decision first on the processor and the price.

■ **Visualize The Video.** Video card technology has grown by leaps and bounds in recent years. As a result, the speed and image quality of new cards from major manufacturers such as NVIDIA, ATI, and Matrox is excellent. However, the features do tend to vary, as do the prices. Certain high-end cards (for example, cards based on NVIDIA's GeForce4 Ti 4600 chipset) tend to cater to speed enthusiasts rather than those looking for a well-balanced video solution. Granted, such lightning-quick cards will deliver a satisfying experience when it comes to video work, but if you're watching your wallet, they're overkill. As long as your video card can handle an XGA (Extended Graphics Array) resolution and support 16- or 24-bit color, you should be in good shape.

Lower-priced GeForce cards (based on the GeForce2 and GeForce3 chipsets) and Matrox's G450/G550 series deliver excellent image quality and plenty of speed at a more budget-friendly price. The Matrox cards are particularly attractive because they feature dual heads, letting you easily connect two monitors for an extra-wide Desktop viewing area. Particularly useful when editing video, you also can use dual monitors with two single-head video cards. For instance, your primary video card could be a



ATI's ALL-IN-WONDER RADEON 8500DV not only includes a TV tuner, video capture and editing, and excellent 2D/3D graphics performance, but it also features a IEEE 1394 connection for transferring digital video.

GeForce2, and your secondary card could be a cheap PCI card based on NVIDIA's TNT chipset (easy to find used for about $20).

If you plan to capture video from an analog source (such as a non-digital camcorder, VCR, or TV), ATI's 7500 and 8500 ALL-IN-WONDER RADEON cards are useful choices because they combine video capture/editing, 2D/3D graphics performance, and a TV tuner in one card. With these cards, you can capture still images and analog video in the MPEG-2 (Moving Picture Experts Group-2) format at resolutions up to 720 x 480 and 30fps (frames per second). In addition, the video-editing software bundled with these cards lets you add effects, transitions, sounds, and more to your video footage.

If you plan to use a digital camcorder (as opposed to the more prevalent and cheaper analog models), ATI's 8500DV video card lets you connect the camcorder to your PC via IEEE 1394 (often referred to as FireWire). If you choose a different video card, you can always pick up a separate IEEE 1394 card for less than $50. Again, this is only necessary if you plan to use a digital camcorder.

Also, please note that if you plan to capture analog video and choose a video card (such as a GeForce card) that doesn't include capture functionality, you'll need to purchase a separate capture card.

■ **Will Your Monitor Make The Grade?** Like video cards, most newer monitors should work just fine for your video endeavors. You'll need a monitor that can deliver 1,024 x 768 resolution, so if your current monitor can't handle that, it's probably time for an upgrade anyway. And even if your current monitor does fit the video bill, so to speak, you might consider purchasing a second monitor to expand your Desktop real estate.

Configuring two monitors (with the help of a dual-head video card or two independent video cards) within Windows is a breeze, and after working with two monitors instead of one, it's unlikely you'll want to return to your one-monitor days. You can use monitors of different sizes if that's what you already have because Windows will make no distinction between the monitor sizes and still expand your Desktop across both screens flawlessly.

■ **Video, Here We Come.** The aforementioned components are the most crucial when it comes to working with video content. You can purchase other necessary system ingredients, such as a sound card, while keeping your eye more on the price. For example, for $25 you can buy a Sound Blaster Live! Value 5.1; this inexpensive card will do wonders when playing back your video sound. A decent set of speakers wouldn't hurt, either, but buy what sounds good to you and fits your budget.

The choice of computer case, mouse, keyboard, CD-RW (CD-rewriteable) drive, and other components are also up to you, as they won't have much of a direct impact on your video work.

By following the hardware guidelines in this article, you'll be able to create a system that handles video content with ease. But before you upgrade your computer or build an entirely new system, it's a good idea to assess your short- and long-term video needs to determine exactly what type of video work you'll be doing most. That way, you can fine-tune your hardware choices to meet your needs.

It's also a good idea to talk with friends and online video forum members to see what equipment works well for their particular needs, although many users have different preferences when it comes to hardware. If you're hedging on two brands of the same hardware device, search for online user reviews of the products, and look into the company's track record. ATI, for example, doesn't update the software drivers for their cards as often as NVIDIA, which causes problems for users of ATI cards when the current drivers conflict with newly released software. If up-to-date hardware matters the most to you, this factor could influence your decision.

Good luck creating your system, and don't forget us when your video endeavors hit the big time. LS

by Christian Perry

The Ultimate Video Machine

Regardless of whether you can afford the ultimate digital video system, chances are good you still dream about it. Technology enthusiasts love to fantasize about owning the killer rig just as the rest of the population dreams about hitting the lottery. Well, we're going to take a step into fantasyland and create that system for you, so hold on tight to your senses *and* your wallet.

Yes, we appreciate the finer things in life, but at the same time, we thrive on finding the best bargains. So, to help this fantasy along, we searched for the lowest street prices we could find for these superior components (at the time this issue went to press) by using Price Watch (http://www.pricewatch.com).

We'll start with an Intel Pentium 4 2.4GHz processor ($525) and 1GB of Samsung PC800 RDRAM (Rambus dynamic RAM; $160). Next, we'll toss in one Seagate SCSI (Small Computer System Interface) hard drive with 36.7GB and 15,000rpm (revolutions per minute; $375, for storing the OS [operating system] files and applications), and two Seagate SCSI hard drives with 181.6GB and 7,200rpm ($2,800 for both; one hard drive is for video capture and the other is for video files). For our primary video display, we'll use a VisionTek Xtasy GeForce4 Ti 4600 ($345), and for our secondary display, we'll use the VisionTek GeForce2 MX400 PCI ($55). We'll also need a nice (*very* nice) video capture card, so we'll purchase Pinnacle's DC2000 ($1,850).

We're not done yet; we need something on which to view the video. Remember, we're aiming for the ultimate system here, so we're going with two 24-inch Samsung flat-panel monitors ($8,260 for both). Of course, we'll want our video productions to sound great during playback, so we'll need a Creative Labs' Sound Blaster Audigy Platinum sound card ($160), as well as a Klipsch ProMedia 5.1 speaker system ($399). All of these fine components need a radical-looking home, so we're going to slap them into a Cooler Master ATX-210 aluminum case ($250).

So far we've only covered the big stuff, but you'll also need a motherboard, CD-RW (CD-rewriteable) drive, mouse, keyboard, rounded cables, and other tidbits. We'll estimate $400 for these items, which brings us to a grand total of $15,579. It's not exactly a cheap system, but it certainly will be a top-notch video performer. For most of us, this dream is only a fantasy. Even so, considering the current prices of typical hardware components on the market today, you could compromise here and there to still build a high-performance system that won't break the bank. □

It's A Codec Moment

How Video Codecs Help Reduce File Size & Decrease Download Time

Without codecs, your endeavors into digital video could be a real mess. That is, unless you simply don't care if your 250MB, 30-second video masterpiece takes a few days to download from your Web site.

But most of us do care about file size, and codecs are here to help. A codec (short for **compressor/decompressor**) can greatly reduce the size of your video file by compressing its data, and then also work by decompressing the file's data when someone views the video. The average computer would have a difficult time displaying an uncompressed, full-screen video, so codecs are crucial when it comes to preparing video for delivery to a widespread (or even not-so-widespread) audience.

There are many codecs in use today by video enthusiasts and professionals alike, and these codecs vary in the way they compress and decompress data. Because of these variances, some codecs are better than others for specific video work. Understanding the way codecs work will help you to both select the proper codec and prepare your video to ensure that the codec works efficiently.

It's important to note the distinction between codecs and file formats. A codec works within a file format (which displays the video) to compress and decompress the video data. There are several video file formats in widespread use today, and these formats can use a variety of codecs. Popular formats include Video for Windows (which uses the .AVI file extension), QuickTime (.MOV or .QT file extension), Microsoft Windows Media Video (.WMV or .ASF file extension), Digital Video (.DV file extension), and RealMedia (.RM or .RAM file extension). Some formats are better than others for specific uses, although many codecs can be used across several formats. For more information about file formats, see "File Fundamentals" beginning on page 84.

■ **How They Work.** Video consumes an enormous amount of space, regardless of whether it's through transmission or physical storage. For example, each second of uncompressed digital video takes up 3.6MB of hard drive space; if you add a few bells and whistles to the video, it'll take up even more space. An uncompressed, studio-quality television signal needs a transmission rate of 216Mbps (megabits per second), which is obviously unattainable with today's Internet data rates.

This is where codecs come into play, as they help to squeeze video into user-friendly packages that can transmit over typical Internet connections and reside on most modern hard drives, with plenty of room to spare. These files also are small enough for today's average computers to play. Codecs work via compression and decompression, and while different codecs might use different technologies, they all operate via the same principle: They reduce the total file size yet return the same (or about the same) end product.

Some compression schemes take advantage of redundancy inherent in the files that need to be compressed. For example, if a file has a long sequence of 1s or 0s, a compression scheme can use a single character to represent that sequence (thereby saving a vast amount of space and reducing the bandwidth necessary to transmit the file). Obviously, our explanation is extremely simplified, but this is the general concept behind compression. Video content often contains plenty of redundancy, so compression works well within the video realm.

In addition, different codecs require different amounts of computer horsepower and bandwidth to transmit decent video image quality, and their techniques are optimized for the type of content and transmission that the video requires. Let's take a look at some of the common compression techniques used by codecs. Some of these methods share traits with others, and some codecs use more than one compression technique.

Lossless and lossy. Lossless compression codecs return exactly what they're given, without introducing distortion. While the image returned by lossless compression is perfect, the rate of compression leaves much to desire, and because of this, video files tend to remain large. With lossy compression, an approximate representation of the original file is the result. Of course, such compression schemes aren't viable for mission-critical environments such as banking, but they work well for video and audio.

Temporal. Many codecs feature temporal compression and involve the interframe technique. Using frame differencing, this technique looks at successive frames of a video file and stores only the differences in the second frame instead of repeating content that occurs in both frames. For example, if a motionless camera recorded a person giving a speech, temporal compression would note that background pixels never change and describe them once instead of describing them for every frame.

Temporal compression also uses motion prediction. With this technique, it predicts pixels in successive frames will have the

same intensity as their prior location (which is the same spot). The compression engine will store only the differences between the predicted value and the actual value.

This compression starts with the first frame of the video clip or movie (called the **keyframe**) and follows with **delta** (or difference) frames that include the differences. Whenever the background or other static information changes significantly, the compression engine may create a new keyframe point at that change, and continue with delta frames from that point on. Some codecs can automatically create keyframes when the content differs greatly from frame to frame, and if you specify fewer keyframes, the file will be smaller but the video quality will also be lower. Temporal compression works well with content that doesn't change much from frame to frame.

But even if the intended recorded content doesn't change much, the lack of a tripod could affect the compression rate greatly, as even static content would appear to change if the camera constantly moves. Also affecting the temporal compression rate are techniques such as pans and zooms. Editing video that's been temporally compressed can be difficult because the compression method makes certain frames dependent on others.

Spatial. Spatial compression takes advantage of the aforementioned redundancies inherent in video content. For example, a blue sky or a white wall might not vary much, if at all, through a sequence of frames. Spatial compression will signify that area of blue sky or white wall with a truncated description that indicates the color is repeated throughout the sequence, thus saving space.

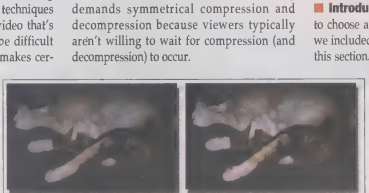
Some codecs use a spatial technique called run-length encoding, which replaces "runs" of similar data (like the blue sky) with a single character. More runs and longer runs result in increased compression. Spatial compression can be adversely affected by video noise and film grain because they interrupt the repeating data. Similarly, this type of compression doesn't work as well with finely detailed or moving backgrounds as it does with more simple or static backgrounds.

Asymmetrical and symmetrical. Codecs control both the compression and decompression of video, and it's often the compression that takes a long time, not the decompression. After all, the decompression must be fast for the video to play in real-time; if a codec decompressed a frame at the same rate it compressed it (approximately one frame per second), the video would become a mere slide show.

Codecs that take longer to compress than decompress are **asymmetrical**. For example, the Sorenson codec decompresses video smoothly, creating great image quality and a good overall video experience. However, you'll pay for that finished product with time, as Sorenson can require a lengthy compression period. The Cinepak codec is also considered asymmetrical because it decompresses much more quickly than it compresses.

(For more information about specific codecs, see the next section in this article, "Introducing The Codecs.")

Symmetrical codecs, on the other hand, compress and decompress video in about the same amount of time. Real-time broadcasting demands symmetrical compression and decompression because viewers typically aren't willing to wait for compression (and decompression) to occur.



This set of pictures represents a sampling of popular codecs, and if you look carefully, you can see differences among all of them. The codecs we used are (clockwise, from upper right photo) H.263, Sorenson, Cinepak, and Indeo.

The H.263 codec is an example of a near-symmetrical codec, and although its image quality may not match that of the Sorenson codec, it can certainly deliver results time-wise.

The type of codec you choose—whether it's asymmetrical or symmetrical—depends on what you're doing with the video. If you intend to use video for a live broadcast, you'll need a symmetrical codec. But if you're looking for high-quality video that users can play on both high- and low-end computers, an asymmetrical codec is a better choice.

Perceptual. Many codecs take advantage of perceptual compression, which focuses on the sights and sounds that humans can experience. Just because a video captured a scene doesn't mean that humans can perceive every visual element in that scene. For example, less bandwidth can be given to color than to luminance because our eyes are more sensitive to luminance than to color.

MP3s also use perceptual compression. Because we don't audibly comprehend certain waveforms in music, the MP3 compression scheme can essentially eliminate them to make the file size smaller. The same effect occurs with video content. Although the final product is not statistically the same as the original, the average viewer won't notice the difference because it still includes the content that is typically detectable by human senses.

■ **Introducing The Codecs.** Now it's time to choose a codec (or two, or three, etc.), and we included some of the most popular ones in this section. As you explore the characteristics of each codec, remember to keep your specific needs in mind.

Radius Cinepak. When the Cinepak codec was first released, it was suitable for use on slower computers and featured a small image size. Today, you can use this codec for compressing 24-bit video for CDs or video files intended for others to download. Although video files using Cinepak can be high-quality, they will also be large. Even so, Cinepak decompresses quickly, and you can set the data rate for playback. Variable and adaptive keyframe-to-interframe ratio controls help eliminate keyframe flashing problems.

Using this codec for the final version of your video is fine, but be warned that its compression isn't speedy, making the process of video editing with it a chore. Cinepak is a good choice when considering universal playback with the AVI format because it runs well with most mid-range computers, but it doesn't fare well quality-wise for Web video. Cinepak works with Video for Windows and QuickTime.

Sorenson. Like Cinepak, Sorenson is useful for compressing 24-bit video for CDs or video files intended for others to download. You can obtain excellent image quality at data rates above 100Kbps, but viewing videos using the Sorenson codec on low-end computers can be difficult.

Also like Cinepak, Sorenson's compression rates are slow, so you should reserve its use for the final product instead of editing. Sorenson codecs veer from Cinepak in picture quality, which is higher with Sorenson, and file size, which is smaller with Sorenson, although the playback of video from CDs demands more hefty system requirements with Sorenson compared to CD playback using Cinepak. Sorenson features VBR (variable bit rate) encoding, block refresh, bi-directional prediction, media key encryption, and multiprocessor support. Sorenson works with the QuickTime format.

Ligos Indeo 5.11. This codec is useful for compression of Internet- or intranet-based video due to its low bits-to-pixel ratio and server-less streaming (meaning that specialized video servers aren't necessary to stream the video). Indeo features Progressive Download, which improves video quality and frame rate as the download progresses. This lets viewers preview the video and then choose whether to view/save the video or skip the process altogether. If they choose to download the video, they'll view a high-quality version the next time they see it.

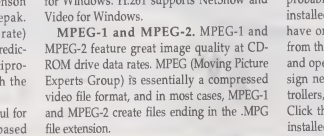
Indeo files are scalable, so the content can be created once and downloaded by users with either fast or slow connections. Also, the files can stream through firewalls. Indeo 5.11 works with Video for Windows, ActiveMovie, and DirectShow.

Intel Indeo Video R3.2. Although Ligos Technology acquired rights to the Indeo software from Intel in 2000, Intel's Indeo R3.2 is still used for compressing 24-bit video for playback from CDs. This codec produces video similar in quality to video produced with Cinepak, although video is compressed more quickly with Indeo. Indeo R3.2 supports both Video for Windows and QuickTime.

RealVideo 9. RealVideo is a popular, scalable streaming codec that features half-screen video at dial-up modem transmission rates and VHS quality at broadband transmission rates (160Kbps and higher). Users need to have RealPlayer 8 or RealOne Player installed to view the streaming content, and as with other codecs, fast computers will allow for the best playback. RealVideo includes HDTV and interlaced support, and you can select multichannel audio for streaming content. RealVideo supports the RealMedia format.

H.261 and H.263. These codecs are primarily useful for videoconferencing because they're built for low data rates and low motion. Both codecs require a speedy processor, so low-end systems could run into trouble processing some data rates. H.263 features better image quality than H.261 and supports QuickTime, NetShow, and Video for Windows. H.261 supports NetShow and Video for Windows.

MPEG-1 and MPEG-2. MPEG-1 and MPEG-2 feature great image quality at CD-ROM drive data rates. MPEG (Moving Picture Experts Group) is essentially a compressed video file format, and in most cases, MPEG-1 and MPEG-2 create files ending in the .MPG file extension.



Programs such as Adobe Premiere present a wide range of codecs for your video projects, so you'll be able to fine-tune your video with the right codec for the job.

MPEG-1 is often used for VCDs (Video CDs) and includes audio and video compression. To play back MPEG-1 video, users need a dedicated MPEG decoder card, and if that's not available, a speedy processor can be used for software playback.

MPEG-2 is often used for DVD video and features good full-screen image quality. However, the quality comes at a price: No software encoding is available, so you'll need a decoder card to play back the video (and when you have the decoder card, any compatible software will be able to play back the video). Because MPEG-2 is best played at high data rates of at least 400Kbps, it's not suitable for network use.

MPEG-1 supports QuickTime, while MPEG-2 supports DirectShow and DVD video players.

MPEG-4. This standard is the successor to MPEG-1 and MPEG-2, and is based on the QuickTime format. In addition, Microsoft's WMV (Windows Media Video) format is its version of MPEG-4.

MPEG-4 features audio, video, and interactivity components that are optimized for delivery over the Internet and wireless devices. Like H.263, MPEG-4 can handle video delivery over the Internet very well, but MPEG-4 features better image quality. MPEG-4 can dynamically adjust to network speeds, unlike MPEG-1 and MPEG-2.

■ **Codec Hunting.** Even if you're new to working with video on your computer, you probably already have a small collection of installed codecs. To see what you currently have on your system, double-click System from the Control Panel (from the Start menu) and open the Device Manager. Click the plus sign next to Sound, Video And Game Controllers, and then double-click Video Codecs. Click the Properties tab to see a list of your installed codecs.

In addition to codecs included with your Windows OS (operating system), many video-related programs and hardware installation CD-ROMs will install codecs. For example, QuickTime 5 includes H.263, Cinepak, Sorenson, and more. You can also download codecs from manufacturer and independent sites. Some codecs, such as the Cinepak AVI codec, require a fee ($129 for the basic Cinepak codec for Windows, http://www.cinepak.com/getcinepak.html).

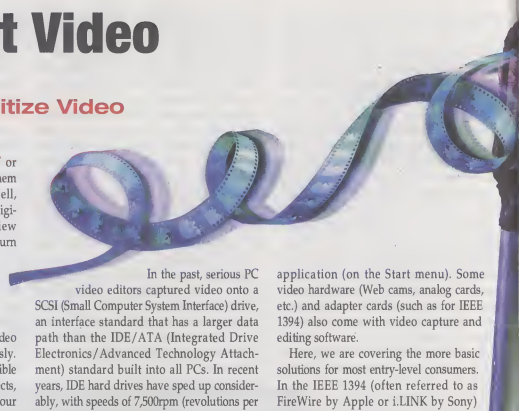
Others are free, including Ligos' Indeo codecs (http://www.ligos.com) and MPEG-4 (http://mpeg4ip.sourceforge.net). Still others, such as Intel Indeo Video R3.2, can be a bit more difficult to find, but a little digging on the Web usually returns successful results (you'll find Indeo Video R3.2 at http://www.autobanners.net/codec/codecs.html).

■ **Board The Codec Train.** By now, you should understand how codecs work, which codecs are popular today, and where to find them. If you haven't previously worked with codecs, try compressing and decompressing your video with several different versions to discover which codec works best for you. You may find yourself using more than one codec for separate video projects. LS

by Christian Perry

Grab That Video

What It Takes To Capture & Digitize Video



Why would you want to "grab" or "capture" video clips and put them onto your PC's hard drive? Well, there are a number of possible uses for digitized video grabs. You can store and view them anytime from your desktop or even burn them onto CDs. In addition, you can email smaller or well-compressed clips to friends and relatives. Budding Webmasters may even want to post clips as streaming video on their Web sites.

But the best thing about a captured video clip is that you can manipulate it endlessly. Once you digitize a video, it becomes possible to edit it into other clips, add titles or effects, and transfer the finished production from your computer onto disc or videotape.

Regardless of whether the video originates from a digital video recorder, a classic tape camcorder, a Web cam, a DVD, or straight off of a television or cable feed, the first step is getting that clip onto your hard drive. There are multiple points of entry for video to transfer onto your PC, and which one you use often depends on the video sources you're using.

First, let's outline the various ways of inputting video content, and then we'll focus on the details of two specific methods: TV/VHS recording via an analog video card and a Web cam recording via a USB (Universal Serial Bus) port.

The Hard Stuff. Before trying to capture video, make sure your PC can handle the load. Perhaps the most important single piece of hardware for this project is a big and fast hard drive. Depending on the quality and screen resolution you use, video takes up gobs of hard drive space because an enormous amount of digital data goes into a full-motion video stream. A 40GB or larger drive can fill up quickly, so look for the largest storage option you can afford.

In order to keep up with that massive flow of bits and bytes, a hard drive also needs to be speedy. Otherwise, the drive will drop frames and introduce video hiccups into the final recording.

In the past, serious PC video editors captured video onto a SCSI (Small Computer System Interface) drive, an interface standard that has a larger data path than the IDE/ATA (Integrated Drive Electronics/Advanced Technology Attachment) standard built into all PCs. In recent years, IDE hard drives have sped up considerably, with speeds of 7,500rpm (revolutions per minute), and upgraded to ATA/100 and ATA/133 interfaces that can allow larger bursts of data to get to the hard drive. In most cases, these are fast enough for all but the most demanding video capture tasks.

If possible, use a second hard drive or a partition of your current hard drive and dedicate it to storing video, as this arrangement keeps the primary hard drive from becoming cluttered and slowed down by other data. Also, for faster, more efficient storage, frequently defragment whatever drive you use for video storage. Finally, smooth video capturing also depends on having a lot of memory, at least 256MB.

The Soft Stuff. You will need video capture software to recognize and record the video feed from whatever device streams input to the PC. Almost all video-editing software also does video capturing. Some of the better-known packages include Ulead VideoStudio ($99.95, http://www.ulead.com), Pinnacle Studio Deluxe ($299.99, http://www.pinnaclesys.com), MAGIX video deLuxe ($49.99, http://www.magix.com), and Roxio VideoWave ($99.95, http://www.roxio.com).

There are also many shareware and freeware capture utilities available, such as Video Capturix ($29, http://www.capturix.com). Plus, Windows XP owners have built-in video capturing and editing with the Movie Maker application (on the Start menu). Some video hardware (Web cams, analog cards, etc.) and adapter cards (such as for IEEE 1394) also come with video capture and editing software.

Here, we are covering the more basic solutions for most entry-level consumers. In the IEEE 1394 (often referred to as FireWire by Apple or i.LINK by Sony) and analog capture card categories, there is a range of increasingly more expensive options for those who want advanced editing features and peerless fidelity to the originals.

IEEE 1394: The Big Plug. For those lucky enough to have a digital video camcorder, the preferred mode of capturing video to the desktop is via an IEEE 1394 connector. These have become fairly standard on DV (digital video) cameras, but this isn't yet the case with most PCs, so you probably will need an IEEE 1394 adapter card that will plug into one of your PCI (Peripheral Component Interconnect) slots. You can usually purchase one of these cards for less than $50, and there are many packages pitched to the DV crowd that have video capture/editing software bundled.

In addition, owners of newer notebook computers may be pleasantly surprised to find that many manufacturers now make IEEE 1394 a standard feature on equipment. Also, Creative Technology, makers of the ubiquitous Sound Blaster PC audio cards, includes the port on its entire line of Audigy sound cards.

The beauty of IEEE 1394 is that it has an enormous bandwidth (400Mbps [megabits per second]) to handle the data rich video stream without any hiccups, and it also lets you

control the connected camcorder from your desktop software.

Once the IEEE 1394 card is properly configured on your machine, all you have to do is connect the camcorder, turn it on, and launch your capture software.

You can do this in WinXP by using the built-in Movie Maker console. Tell the program to accept input from the IEEE 1394 connector, and Movie Maker will display a standard set of play and record buttons which now control your linked camcorder remotely. From here, you can record directly from the DV camcorder to your hard drive, using the controls in the capture software to move anywhere on the DV tape and select the clips you want. Some software/hardware combos also let you **batch capture**, which involves tagging the clips you want to capture into your PC so that they can be recorded onto the hard drive all at once and in whatever sequence you like.

In addition to its great speed and versatility, the biggest advantage of using IEEE 1394 to transfer DV material is that it is a purely digital transfer and so there is no degradation of the signal. Unlike dubbed analog audio or videotapes, which introduce additional hiss or image degradation with each copy of a copy, the process of capturing DV video to a PC produces an exact replica of the original.

■ **USB: Trying To Keep Up.** Some video devices, particularly Web cams, some external PC TV tuners, and occasionally older DV camcorders, will use the USB connector to transfer video to your PC. This is a much slower, less flexible route than IEEE 1394 and is best reserved for low-resolution (320 x 240 and lower) video streams.

USB has limited bandwidth and often experiences interference from other devices that use the PC bus at the same time. A much richer USB 2.0 standard is beginning to appear on newer PCs, so by next year we should see external video capture devices that deliver much more reliable video streams at higher resolutions.

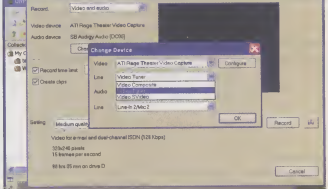
The most common USB video device is the Web cam, which many people use to record small video streams that consume less storage space than many other video capture techniques. As we'll see in one of our later examples, Web cam video is not as smooth, sharp, or large as other video capture techniques, but its small file size makes it ideal for posting it to the Web or emailing others (including video email).

There are some external TV tuner cards that connect to your PC via the USB port. With these, you can record directly off of a cable TV feed, or in some cases, from a connected VCR.

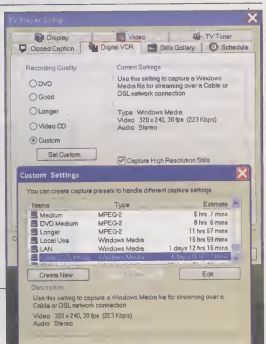
There also is a line of dedicated video capture devices that use USB ports. Dazzle (http://www.dazzle.com) is one of the better-known manufacturers of these units, which are expressly designed for capturing video streams from camcorders, VCRs, or televisions and transferring video to a PC. Typically, these capture units come bundled with video-editing/capture software and let users easily take still snapshots from a video or convert the stream for CDs, video email, or Web video. Again, the bandwidth is narrow, but for low-resolution clips, especially ones you plan to use on the Web, it probably will suffice. Nevertheless, units such as these from Dazzle promise that they can capture 30fps (frames per second) of video at low resolutions.

Despite bandwidth limitations, there are distinct advantages to using a USB connection to capture video. First, these connectors have been standard on PCs built in the last several years, so no additional hardware is required. USB also has convenient plug-and-play operation. This is perfect for those hardware-averse PC owners who would rather not crack open their case and insert a new card. In most cases, when you plug in a USB Web cam or video capture device, Windows will recognize the new device and ask you to install the bundled software. From there, you are ready to view your Web cam image on your monitor or capture stills and video with it.

Finally, USB video capture is an easy and cheaper solution for notebook computer owners who do not have a IEEE 1394 port. Many of the more basic USB video capture devices can



Windows XP's built-in video capture/editing software is Movie Maker. It can monitor and record input from IEEE 1394 or USB (Universal Serial Bus) ports as well as internal analog video cards.



Full-featured video capture software, such as this one from ATI, lets users choose from a wide range of video file formats with image and file sizes and various quality settings.

be smaller than a deck of cards, making them perfect for portable devices.

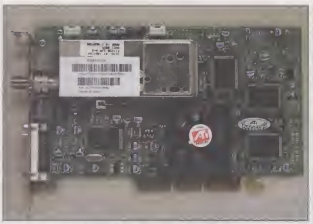
Analog Video Cards: The Mainstay. Although IEEE 1394 and USB 2.0 may become the ports of choice sometime in the future, the most common method of grabbing video is still the internal analog video card. Typically, these are PCI add-on cards that work with your current video and sound cards to play and record all flavors of analog audio/video input to the PC desktop.

Virtually all analog boards have RCA-type A/V inputs, which accept signals from a VCR or camcorder. Many also have S-VHS input, which delivers higher resolution and better color-separation from S-VHS VCRs, DVD players, and even video gaming consoles. In addition, the typical consumer-grade capture card also has a cable TV jack for recording directly off of an antenna or cable TV signal. Some of the more common manufacturers of these video cards include ATI Technologies (http://www.ati.com), Hauppage (http://www.hauppage.com), and Pinnacle Systems (http://www.pinnaclesys.com).

Because the analog capture card market is highly evolved, and many professionals continue to use these cards, there is a wide range of products available at price points from $50 to several thousands of dollars. We will stick to the low-end of that scale as we cover these devices, but ambitious and deep-pocketed video hobbyists can pay more if they want advanced circuitry that allows for fancy video effects processing and more professional-grade video output.

The typical consumer analog card fits into a PCI slot and accepts the various A/V inputs on the back of the card. In order to also hear and record the sound stream, most cards require that you connect the audio output from the add-on card to your sound card's line-in channel via a simple miniplug. The card's software drivers help it work with your current display card so that the video feed is available in a window.

If the card has a built-in TV tuner, it will accept TV feed and let you surf channels on your desktop the same way you would on your living room television. Some recent TV tuner cards even come with a remote control.



This is one of ATI's ALL-IN-WONDER cards, a typical multifunction analog video capture card, that combines video input/output with 2D/3D Windows acceleration.

There are also several combo cards that add analog capture capabilities into a standard 2D/3D video card. One of the best known, the ATI ALL-IN-WONDER cards, is what we used in our video capture example (in the next section of in this article, "From Tape To Hard Drive"). Some makers of NVIDIA GeForce cards are also adding various levels of video input support.

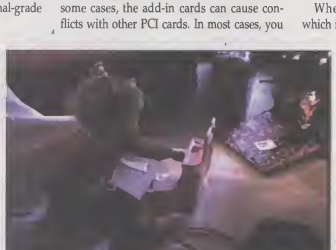
The upside of analog capture cards is that they are very flexible, all-purpose solutions for the most common types of video input. Most of them also come with capture software that is highly evolved and can grab both streams and still snapshots in a range of resolutions that consume more or less storage space.

The downside is that they can be more complex to install than the other solutions, and in some cases, the add-in cards can cause conflicts with other PCI cards. In most cases, you can solve these issues by trying the capture card in different PCI slots, but this also requires more confidence and knowledge about your hardware.

Finally, any analog-to-digital transfer involves some degradation of the original video signal. For absolute fidelity, capturing a digital video signal directly to a PC via an IEEE 1394 connection probably will be the optimal choice when that technology becomes more commonplace. For now, an analog card is the more common route, and because of this, we'll use an example featuring an analog card to walk you through a basic video capture process.

From Tape To Hard Drive. For our sample project, we will illustrate one of the most common capture activities, transferring video from VHS tape to a hard drive, where you can edit it, post it online, or email it. We used an ATI RADEON ALL-IN-WONDER 8500DV card, which has analog A/V input and output integrated with a 2D/3D video accelerator. The only additional piece of hardware we needed for this project was a VCR and a set of RCA-type A/V cables. These cables carry right and left stereo sound channels, plus the video channel from the output jacks on the back of standard VCRs (the same ones that connect to your TV set), to the A/V inputs on your analog video card. In this case, the ATI card uses a breakout box, which holds all of the various input and output jacks at the end of a thick cable that then connects to the back of the video card in our PC.

When launching the capture software, which in this case is ATI's Multimedia Center, we had to tell the program which A/V input channel to use: cable TV, S-VHS, or composite. Composite is the channel that usually carries the signal from a connected VCR. Once the software is set to the correct input, we were able to press the Play button on the VCR and see the tape play on the desktop.



Using the Windows Media format, we recorded 60 seconds of home video at a lower resolution to create a file with a final size of only 1.6MB.

Before starting the capture, we had to choose the video quality at which to record, and this determines how large the file will be for that clip. The ATI software gives many capture options, from DVD-quality captures in the MPEG format, which can fill a PC screen, to postage stamp-sized

low-resolution Windows Media format windows that are best for emailing and streaming video from Web sites.

Now it's time to do a sound check and cue up the VCR. Because the audio tracks are coming through the line-in channel of the audio card, it is important to check that channel's volume setting and whether it is muted. In either WinXP or Windows Me, double-click Sound from the Control Panel. Below the Volume tab, open the Advanced options to get volume and muting controls for all audio channels in and out of the sound card. In most cases, the line-in channel is the one used for the capture card.

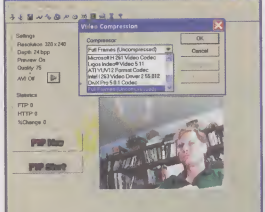
Whether recording from a VCR, DVD player, or camcorder, when using an analog capture card, the PC only controls the recording function. We needed to cue up the video on the VCR to find the right spot to start recording, and then click the record button on our PC's capture software to start the capture. Typically, the capture software displays a window that tracks the elapsed time of the recording, in some cases, it even tracks the disk space being used.

We recorded a Christmas morning home video from a standard VHS tape. One minute of recording in the MPEG-2 format (the same as DVD quality) in a 740 x 480 resolution and 16-bit stereo audio consumed 60MB of hard drive space. The resulting video was almost indistinguishable from the original tape, but our software warned us that we only had enough room on the hard drive for less than an hour of recording at that quality level. For amateur video editors who want to splice together these digitized clips and convert them back to videotape, this high-resolution setting is preferred.

One minute saved to the Windows Media format at a 320 x 200 resolution and stereo audio, however, consumed only 1.8MB of space. This video was considerably smaller and a bit fuzzier than the MPEG-2 version, but it was otherwise watchable.

Web Cams: Video Streams On The Cheap. If you don't have a camcorder or spare VCR to hook up to your PC, Web cams can be a cheap and easy solution. Most Web cams and their bundled software can capture a low-resolution video stream at low frame rates. Our 3Com Web cam cost less than $100. It hooked up to the PC via the USB port and asked for the requisite software. Much like the capture software for an analog capture card, the Webcam32 software that comes bundled with this unit puts a live feed from the video source on the desktop and lets you snap still images or record a video stream. Once the Web cam is properly installed in Windows, a drop-down menu will include it in its list of possible video feeds to run in a window.

Our copy of WebCam32 came with a simple click-and-record button for capturing the live stream to an AVI format video file. A video options window let us choose between a higher frame rate (for smoother movement) and better resolution (for sharper edges and more detail). Most Web cams also let you set the size of the viewing and recording window. Ours ranged from 128 x 96 to 640 x 480. Once these options were set, we simply had to click a green AVI button and a pop-up menu asked whether to record the stream uncompressed or to squeeze the file size using one of several compression schemes. Our minute-long uncompressed Web cam stream (at 320 x 200) weighed in at 3.2MB. We were able to shrink the file size down into a compressed zip file of 1.2MB, which was more manageable as an email attachment.



Web cam software, such as WebCam32, lets users compress video with various methods that Web browsers and video players can decode.

Generally, Web cams are rudimentary cameras, so they have a low resolution and record streams at lower frame rates. Our finished AVI file was much fuzzier than the file produced by our analog card, and the movement was jagged. Nevertheless, the file rendered a usable stream for a Web page, and we were able to compress it down to a manageable 1.2MB in a zip file. Best of all, compared to the cost of a camcorder, the Web cam route is simple for video streaming and very inexpensive.

Although the results are less sharp and smooth than other forms of video capturing, most Web cams can record video streams at resolutions up to 640 x 480.

Learning how to capture video on a PC may well become as rudimentary a skill as recording a TV show on a VCR. The desktop is fast becoming the hub for the next generation of home video and photography buffs. In this world, friends and relatives will pass around videos via broadband connections in much the same way snapshots are mailed today.

For now, budding digital movie moguls need to cobble together the right technology to make video capturing work smoothly. Newer desktop systems, such as the latest VAIO models from Sony, fully integrate IEEE 1394 ports, analog video input, video capture/editing software, and even CD- and DVD-writing capabilities, turning the common PC into a full video-editing deck and production facility. Considering our love of home movies, we expect this to be the norm rather than the exception in just a few years. LS

by Steve Smith

Transfer Video To Disc

Burn Your Own Movies Onto DVDs & CDs

One of the great by-products of this "digital age" is that anyone with a PC has access to some of the same tools for creating media that once cost hundreds of thousands of dollars and lived only within the walls of Hollywood production houses. With DVD burners coming down to a reasonable price, it is now possible to transfer your own home videos onto discs. In fact, as we found out in putting together this primer on DVD creation, even owners of CD-R (CD-recordable) and CD-RW (CD-rewriteable) drives can join in the fun. With some limitations for storage space and playback options, it turns out that we can burn DVD-like content onto CD-Rs with a standard CD-R or CD-RW drive.

Some basic hardware is required. We thought we needed a lot of hard drive room to capture video and stills until we made a DVD. Because the final product can be up to 4.7GB of data, and those clips need to be manipulated, processed, and stored first, count on having free hard drive space equal to two or three times your project size. A second drive or partition dedicated to video storage is ideal, and keep the drive well defragmented to minimize the disc thrashing that can cause video burps. As for choosing a blank disc format, much of this depends on your drive manufacturer. Dell, Hewlett-Packard, and Philips seem to be in the minority in pushing the DVD+RW format, while most other drive manufacturers are employing the DVD-R format, which is the blank disc format we used for our project. Now all we need is software . . .

A range of DVD-creation programs have emerged with an equally wide selection of features and price points. Consumers should be aware that there are two classes of DVD-creation software. Many DVD-authoring programs will indeed make the menus, add effects, edit the clips, and render the video into a DVD format, but they will not always be able to write the final product to a recordable/rewriteable DVD drive. (See the "Your Software Options" sidebar for more details.) For our project, we used Ulead's new DVD Workshop ($299; http://www.ulead.com), a mid-to-upper-level package that handles all the stages of DVD creation: capturing/importing video, converting noncompliant video formats into the DVD format, authoring and editing, and burning directly onto DVD-Rs or CD-Rs.

Collect Your Media. Like most editing software, DVD Workshop let us capture video directly into the editor from an attached video device and import stills and video already on our hard drive. We made sample projects involving both techniques.

The Start Project dialog box directed us to give this DVD-to-be a working title and declare the output format we intended: DVD, VCD (Video CD, which can be played from any CD-ROM drive) or SVCD (Super Video CD, a higher resolution VCD format). Pay attention to where the program is planting the project on the hard drive because you may want to keep the enormous files produced by DVD-authoring software on a separate drive or partition.

Our first project was a typical compilation of home videos, a DVD of clips from a little girl's third year of life. In this case, our clips were on VHS tape, which we hooked up to a common analog video card for playing and recording on a desktop. Programs such as DVD Workshop also can capture video clips from a DV (digital video) camcorder through an IEEE 1394 port or just about any other video source that your PC can handle. Our program is divided into a workflow of top line tabs that move us from Start,

In the Ulead DVD Workshop window, the captured video clips appear on the Title Bar, which is essentially the storyboard where you can arrange the video project's sequence of scenes.

Capture, and Edit phases to Menu (creation) and Finish, where we can preview the project and write it to a disc.

In the Capture phase of DVD production, a Capture Settings button let us choose the input source for our video feed: the composite channel on our analog video card, which was

connected to a VCR. The settings menu is also where we set both the frame size for the capture (we chose the default 320 x 480) and the quality of the audio capture (8-bit mono), but you can record at up to full DVD resolutions and up to 16-bit stereo. The video stream from our connected VCR appeared in the capture window, letting us cue up the pieces of tape we wanted to assemble for our project. It is not critical at this stage to edit the clips precisely or put them into a particular order, as that process takes place during the Edit phase. Capturing is just a matter of running the tape and clicking the Capture button to start and stop the capture. The program automatically turns each capture into a title, a raw piece of footage that you will assemble later into the edited clips and menus of the DVD.

Another way of assembling footage and images is to import files that are already on the hard drive. DVD Workshop has a Video Library window that let us switch among collections of stills, videos, and audio tracks that you can drag and drop onto the Title Bar to insert into your storyboard for slides, menus, or clips. The Library Manager let us navigate to the directory containing another family video file. This clip loaded into the library of thumbnails, and from there, it was just a matter of dragging and dropping the clip into the storyboard. With the four scenes we needed to load, it was time to go into the heart of the authoring process, the Edit phase.

Cut, Paste, Drag & Drop. Before discussing to the Edit phase, let's cover some basic DVD terminology. A homegrown DVD is composed of three main elements: titles, chapters, and menus. Titles are the individual pieces of footage that make up our total project, which in this case, are the four separate pieces of home video we loaded onto the Title Bar. Chapters are the entry points to the video and are also linked to the menu. Each title can have more than one chapter if we want to give the DVD user direct access to specific sections or scenes within a title.

Every DVD allows a "First Play" sequence, a still image or video clip that runs automatically when a DVD first loads (and before the main menu appears). For our compilation, we chose a still of our 3-year-old's birthday that we captured from one of the titles. This image, along with some background music, will introduce our DVD and appear on-screen for several seconds before the DVD's main menu displays.

In DVD Workshop's Edit mode, the Title Bar's first frame is for the First Play selection. We dragged our still frame onto that area and highlighted it. A drop-down menu let us assign a specific music file from the audio library to play in the background during this introduction.

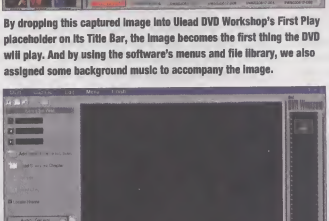
Now it was time to trim and arrange the titles. We were able to rearrange the title sequence by clicking and dragging each one around on the Title Bar. Right-click menus also let us insert directions for the DVD to move onto the next title when the previous one finished playing. The other option is to have the DVD return to the top navigation menu at the end of any or all of the titles.

Setting the Mark In and Mark Out for each title is how to trim a piece of video. Double-clicking a title displays it in the preview window. Beneath the window, a Jog Bar let us move to any frame in the title. When we found the frame where we wanted the sequence to start, we clicked the Mark In button beside it to tell DVD Workshop where the title should begin in the final product. Likewise, moving the Jog Bar to the last frame we wanted and clicking Mark Out set the end point for this clip. This marking process does not actually trim the original video capture that is now stored permanently on your hard drive; it simply tells DVD Workshop what piece of that clip should be processed when it makes the final product.

Each title is, by default, a single chapter in the Chapter List on the far right side of the program window. Chapters are the entry points you establish on the DVD's menu for quickly finding one of the titles. If each title has a single chapter, as ours do, we'll have a single entry point at the start of every title. If one of our titles happened to be long, or if it included several different scenes, we could give it multiple chapters. To do so, we would simply move the Jog Bar to the point in the title where we wanted a new chapter and click the Insert Chapter command. We could also use the Cut Title command wherever the Jog Bar is set to clip a single title into two pieces.

From this window, we can also capture any frame from a title as a still image by clicking Add Current Frame To Library. These screen captures are useful for a First Play sequence, in a slideshow that can be created on the DVD, or even as a background for the menus. Another important consideration is which frame in the title to use as the chapter thumbnail. When we get to the next stage of making the menu for the DVD, we can use

By dropping this captured image into Ulead DVD Workshop's First Play placeholder on its Title Bar, the image becomes the first thing the DVD will play. And by using the software's menus and file library, we also assigned some background music to accompany the image.



In the Edit phase, we trimmed each video clip by using our software tools to set the edges of the green bar beneath the preview window to specific Mark In and Mark Out points.

these thumbnails as the navigation buttons the user presses to access that chapter. By default, DVD Workshop makes the first frame of the chapter its thumbnail in the Chapter List, but that may not be the most recognizable or representative frame. To change this, we double-clicked the relevant chapter in the Chapter List, which displayed the beginning of that chapter in the preview window. We moved the Jog Bar to the frame we wanted to serve as the thumbnail, and then right-clicked the chapter in the Chapter List. The context menu let us choose Set Chapter Thumbnail for the chosen frame.

During the Menu phase, we dragged the video chapters from the list on the right into the open placeholders of the menu template to establish the DVD's navigation buttons. Then, using Ulead DVD Workshop's text tools on the left, we inserted labels and menu titles just as we would in a graphics program.

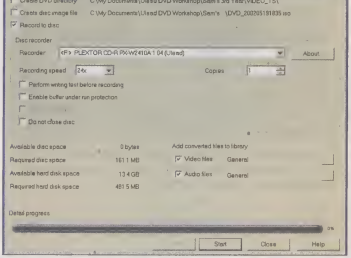
■ **Navigate Me.** With all of the clips trimmed and ordered, as well as all of the chapters designated and labeled with helpful thumbnails, we were ready for the Menu phase. When choosing the Menu tab for the first time, you'll see the Menu Template Wizard, which let us choose from some common DVD menu layouts. These templates have open slots for making chapter thumbnails into navigation buttons as well as preset buttons for basic DVD operations, such as Play, Return To Home Menu, Play Next Chapter, etc. We chose the simplest route, a template that had room for four chapter thumbnails/buttons. In the Menu phase, a series of tabbed command menus appears in the upper left, which let us build different attributes into menu, its buttons, and its text.

From here on out, it was all a drag-and-drop operation. On the right side of the window, there is a Title Selector that let us move through each title in our project, while displaying all of the chapters in each title above it. The general idea in making DVD menus is to create a button on the home menu and link it to the chapter we want that button to play in the final product. DVD Workshop makes it easy to do this automatically by clicking on a chapter and dragging it onto one of the open spots on the menu screen. The link is made in background. Another option is to create a button out of some other image, such as the sample icons in the program's button library. In this case, we would start with a blank background and drag icons onto the home menu screen to serve as buttons. Then we would drag the relevant chapter from the Chapter List onto that button to create the necessary link.

Menus can be as elaborate as the home movie mogul likes. In DVD Workshop, the menu background itself could be animated, and even the navigation buttons can be full motion clips from the chapters rather than still frame captures. One tab in the command menu sets several options for how buttons appear on-screen, including the type of frame around each, the image attributes of the thumbnail, and what shade of color the thumbnail becomes when it is highlighted by the DVD user. In each case, it is a simple matter of highlighting the button in the menu preview screen and choosing the frame style, color, or other attribute from a drop-down menu. We could also make submenus in much the same way that feature film DVDs start with a home menu of buttons that play the film or launch submenus for scene selections and special features. If our DVD had a wealth of clips, we could create submenus with more chapter buttons, and then simply link them to navigation buttons on the home menu in the same way that we linked menu buttons to the video chapters.

In our case, we stuck with a single home menu that contained thumbnail images linked directly to the clips. We did need to add some labels for the production and buttons.

The final tab in the Menu phase is for text, which works just like the text function in any graphics program. We chose a Broadway typeface in different sizes for the overhead title of our menu and short descriptive blurbs to label each chapter. With the mouse, click anywhere on the menu screen to make an insertion point, and then type in the text.



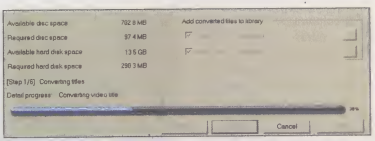
Although Ulead DVD Workshop lets users save video projects to the hard drive as a disc image file that can be written to a blank disc later by a separate program, we directed the software to burn our video project directly to a disc.

■ **Burn, Baby, Burn.** Once the Capture, Edit, and Menu phases are complete, the production comes together in the Finish phase, the final tab in DVD Workshop, which let us preview the final product and write to the disc. The Finish phase was where we could play the project in its current state to see how it would look on a DVD player. Here, we tested to make sure the background music played properly in our First Play screen, the menu buttons all linked properly to the correct clips, and the Mark In and Mark Out settings we established in our Edit phase trimmed the clips the way we wanted. It is

important to note that users can return to any of the previous stages in this production process, even during this Finish phase, to change any aspect of the project. None of the choices we made in the earlier phases actually processed until we elected to burn the disc.

When it's time to process and burn a DVD project, a good disc-writing package offers many options. DVD Workshop has what Ulead calls the MPEG Now decoder, which effectively takes whatever image, audio, and video formats you captured into the project and coverts them into the MPEG-2 (Moving Picture Experts Group-2) format used in DVDs. This all happened when we issued the Make Disc command. The program let us choose to write the DVD in various quality levels, from a high-quality data feed of 8,000Kbps (kilobits per second), which would squeeze up to 60 minutes of data onto the disc, to 1,500Kbps with more than 6 hours on a single disc. Because our source material was a VHS tape, which would not take advantage of a higher-quality transfer rate anyway, we went for a medium-quality burn. This is also when we saved the project so we could modify it later or retrieve it for writing a second copy of the DVD.

The final options screen gave us a choice of transferring the DVD content to our hard drive, making a disc image (which we could burn onto a blank disc later from another disc-burning program), or burning directly to our disc drive. This screen also told us the size of the final project, which in this case, was a relatively puny 161MB. That was small enough to fit on a standard 700MB CD-R, so we burned our project onto a CD-R using a CD-RW drive and onto a DVD-R using a DVD-RW drive to compare the results. Be forewarned about the final phase of writing to either media: the wait. Because the DVD-writing program must process and assemble all of those menus, clips, and soundtracks, first onto the hard drive and then onto the disc, the last step can take from 15 minutes for our tiny test project to an hour or more for projects with longer video and more involved menus. One DVD that we created with motion menus took more than an hour. It was also important to heed the amount of hard drive space the program would need to process everything. Our 161MB disc burn actually required 481MB of storage space to work in. You can just imagine the headroom one needs for a disc with hours of video.



The final stage of our DVD creation project involved the lengthy processing of all the video elements we made earlier and converting them all to the proper MPEG-2 (Moving Picture Experts Group-2) DVD format.

We discovered that indeed one can write DVD content to a standard CD-R using a CD-R or CD-RW drive, but there is a problem associated with it: With standalone DVD players, it turns out that CD-Rs are read as a newer DVD "mini-disc" format, which only the most recent and well-equipped units can handle. The good news is that CD-Rs and DVD-Rs seem to play fine on all PC DVD-ROM drives using DVD player software. On the other hand, the burn we made to a DVD-R using a DVD-RW drive played fairly well on everything—even a Playstation2. The only weakness involved the audio track, which one player wouldn't pick up at all and another played at low volumes. The desktop software DVD players had no problem with it, however. Apparently, there are compatibility problems between DVD-Rs and some standalone DVD players. Ulead tells us that the most recent standalone DVD players are the most reliable for running DVD-Rs as flawlessly as desktop software DVD players.

■ **The VCD Alternative.** The VCD (Video CD) and SVCD (Super Video CD) formats are something like a poor man's DVD. They burn video onto a 700MB CD-R using MPEG-1 and MPEG-2 compression schemes respectively, and they can be played back with most CD-ROM drives using readily available freeware players. We were able to make a basic SVCD using DVD Workshop. When starting a new project, simply elect to make an SVCD, and then use the capturing and editing phases to assemble a storyboard of video clips. In the Finish phase, DVD Workshop then offers only one disc-burning quality option: to a 700MB CD-R. This also is a good way to archive video clips so that they are compatible with all PCs.

With the current crop of authoring and burning software, making DVDs is easier and a lot more fun than one might think at first. And as the DVD-RW drives themselves plummet to less than $400, this may well be the next big hobby for audio/video geeks. We have our home videos lined up already for the DVD transfer treatment. But first, we will be looking for the biggest, fastest hard drive we can find. Processing DVDs eats up hard drive real estate faster than a new version of Windows. And that's saying something. LS

by Steve Smith

Your Software Options

Many DVD authoring programs offer a full suite of editing and special effects tools, but they sometimes require a separate program for actually burning the project to a recordable DVD or CD. Because the market is evolving quickly, check a program's feature set to see if it includes the tools you need before purchasing it.

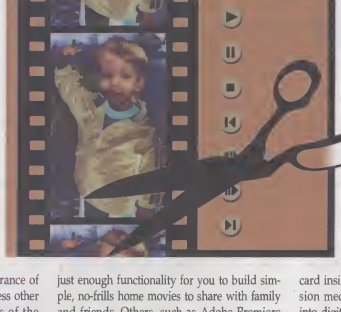
DVD Authoring

Adobe Premiere ($549, http://www.adobe.com)
Dazzle DVD Complete ($99.99, http://www.dazzle.com)
MAGIX video deLuxe ($49.99, http://www.magix.com)
Pinnacle Express ($49.99, http://www.pinnaclesys.com)
Roxio VideoWave ($99.95, http://www.roxio.com)
Sonic MyDVD Video Suite ($99.99, http://www.sonic.com)
Stomp RecordNow MAX Platinum ($79, http://www.stompinc.com)

Digital Video Editing Overview

Turn Footage Into Films

Sculptors work in clay, painters in oil, poets in words, and filmmakers—at least, those of the 21st century—in bits. Everyone from the amateur video enthusiast to the award-winning movie producer, including the likes of George Lucas and Mike Figgis, has embraced the digital medium. Even those who choose to record on analog film are opting to edit in a digital environment.



And why not? Digital video offers superior image quality, low operating costs, and a wealth of editing possibilities. Indeed, because the footage exists as digital data, the filmmaker can add or remove content, rearrange scenes, alter the appearance of individual frames, and perform countless other editing tasks with only a few clicks of the mouse. All that's needed is a general understanding of the terms and concepts involved.

■ **An Editor For Editing.** The process of digital video editing cannot begin until you have the proper equipment. Obviously, you need a robust machine equipped with a powerful processor, plenty of memory and storage space, a sound card, a video card, and other necessary multimedia components. See "Upon Further Review" on page 36 for a full discussion of equipment requirements.

Although all of the equipment is important and necessary, the one component that is inextricably linked with the editing process is the video-editing software. This software provides the set of tools that lets you gather, arrange, and compile a diverse body of multimedia data into a finished movie. It also serves as the workspace where you can put these tools into action.

The video-editing programs that are available today vary widely in their capabilities and prices. Some, such as Windows Movie Maker (free with Windows Me or Windows XP; http://www.microsoft.com/windows), offer just enough functionality for you to build simple, no-frills home movies to share with family and friends. Others, such as Adobe Premiere ($549, http://www.adobe.com), provide an array of complex features that let you create professional-quality videos for business or entertainment purposes. See the "Our Video Editor Choices" sidebar for more information about some of the best products currently available.

Regardless of which video-editing application you buy, make sure your PC supports it, and it matches your skill level. A first-time user who wants to combine several video clips into one file should stay away from high-end programs that require knowledge of advanced editing procedures. So, too, should advanced users avoid low-end products that limit functionality in favor of intuitiveness.

■ **Talk The Talk.** The best equipment in the world cannot guarantee competence. It takes a certain amount of acumen to use that equipment properly. Fortunately, you do not need to study thick textbooks to become proficient as an editor of digital video. All it takes is an understanding of the basic terminology and concepts. Once you learn how to talk the talk, you soon will be able to walk the walk. We recommend taking a few minutes to acquaint yourself with the subjects you'll encounter in your editing endeavor.

Capture. A video-editing application is useful only if you have some digital footage to edit. The process of getting editable footage is referred to as a **capture**. You have several options for capturing data.

The first option is to record the action in a digital format while it's happening. You can do this with the help of a digital video camera. The camera captures live video footage and stores it as a digital file. You then can transfer the file to a PC, often through the computer's USB (Universal Serial Bus) or IEEE 1394 (often referred to as FireWire) port.

Another option is to use a Web camera, which connects directly to your PC and captures low-resolution video. Web cams are much cheaper than digital video cameras but have limited capabilities. Typically, you cannot use them away from your PC, for instance, and the cameras have few, if any, control mechanisms.

The third option is to use a video capture card. A video capture card, which takes the place of the video card inside your computer, contains a conversion mechanism that translates analog video into digital data. It doesn't matter if the analog source is a videotape or cable television. The card will convert the footage into a digital format so you can use it on your PC.

Clips. A professional filmmaker knows viewers will get bored if they're forced to watch all of the action through the lens of one camera. That's why a filmmaker uses multiple cameras to film a scene. He and his crew then divide the resulting footage into pieces, called **clips**, that they selectively edit to produce the finished program.

Clips form the backbone of any digital video project, including those created with the help of an editing application. Indeed, clip creation and selection are two of the first and most important steps you will take in constructing your digital movies. You should select clips that are coherent, relevant, and of uniformly high quality. Statistically, the selected clips should represent a mere fraction of the total video footage at your disposal so you can choose only the best.

All video-editing applications support the use of clips. Most consumer-oriented video-editing applications, including Windows Movie Maker and Roxio VideoWave ($99.95,

http://www.roxio.com), divide digital files into clips automatically. These programs use natural breaks in the footage, such as a change in lighting or background color, as the starting and ending points for each clip. Some of the high-end programs, such as Adobe Premiere and Avid Xpress DV ($1,699, http://www.avid.com) also allow for manual clip creation. Advanced users tend to prefer this option because it gives them complete control over the clips in their projects. These programs may feature an automated clip creation feature, but it is typically disabled by default.

Note that the clips are essentially marked sections of a digital file and not individual files themselves. So, if you delete the original video file from your hard drive, you will delete all of the related clips, as well.

Library. Once your clips are created and selected, they are listed in the editing application's media library. They wait there until you decide to incorporate them into your project. The library, which may also be called a collection or bin, can hold video clips, as well as audio files, digital images, and other forms of multimedia data. Most video-editing programs divide the library into sections, each of which hold a certain type of data.

Video-editing programs feature an import command for bringing multimedia files into the library. Many also let you drag and drop files into the library.

Storyboard and timeline. Having the multimedia files is one thing. Putting them together is something else. To get the job done correctly, you need a workspace where you can lay out your clips and multimedia files. That's where the storyboard and timeline come in. Every video-editing application has a timeline or storyboard, and most have both.

The storyboard is a virtual bulletin board where you can arrange your clips and digital images in a logical order. You can think of it as a rough outline for your video projects, on which you get to decide which visual elements should come first, which ones should come last, and where the rest should fall in between. You can arrange clips on the storyboard simply by dragging them from one position to another. Our advice is to use the storyboard to determine the most effective way of presenting your data.

The timeline, which complements the storyboard, is the workspace where you insert the transitions and other special effects that transform your collection of individual clips into a unified video presentation.

The timeline also tells you the exact duration of each clip and provides the tools you need for trimming clips to a desired length. Although most timelines offer similar functionality, those designed for high-end programs provide special features that give you maximum control over the editing process. Adobe Premiere, for instance, lets you zoom in on the timeline so you can edit the clips frame by frame if necessary.

Tracks. A track is a stream of continuous audio or video data within a digital movie. The simplest video-editing applications have two tracks: one for audio and one for video. Advanced applications can have many more. For example, MAGIX video deLuxe ($49.99, http://www.magix.com) supports 16 separate audio tracks and 16 separate video tracks, for instance, while Adobe Premiere supports 99 of each.

In addition to offering support for multiple tracks, advanced applications also sport intricate control mechanisms for each track. These mechanisms may let you adjust the volume of the track and the track's playback speed, among other things.

You can't edit video without video-editing software. Adobe Premiere, which offers robust editing functionality, is one of the more popular products on the market today.

You should use multiple tracks whenever you combine multimedia elements. For example, you may choose to open three audio tracks for your project: one for background music, one for narration, and one for sound effects. Maintaining separate video tracks for video clips, transitions, and digital photos is another way of organizing multimedia data within a project. Even though it's unlikely you will ever need to lay down 198 tracks in your homemade video projects, you certainly will find occasions that prompt you to take advantage of multiple tracks.

Transitions. In traditional video editing, you might use tape and a sharp razor blade to join a pair of film clips. If successful, the **splice** (the area where the two clips come together) would manifest itself as a plain shift from one clip to the other. A less successful splice would create a messy break and result in the loss of potentially valuable footage. The latest crop of digital video-editing applications makes the process of joining multiple clips an effortless (you might even describe it as fun) experience.

The difference lies in the use of transitions. A **transition** is a graphics effect that ties together abutting clips in a video presentation. You should insert a transition into the timeline at the point where the two clips intersect. Common transitions include the **fade** (where the upcoming clip slowly fades in as the preceding clip fades out) and the **wipe** (where the upcoming clip appears to wipe the preceding clip off the screen), but most video-editing applications offer dozens of transitions for users to incorporate within their projects. The editing programs also let users configure the transitions for length, direction, color, and effect.

As with fonts on a Web page, transitions are often overused by eager amateurs who want to spice up their videos. Transitions should be subtle and uniform. Pick one or two that you use consistently throughout your project.

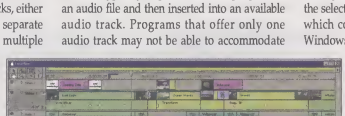
Filters. Transitions represent just one of several special effects that are available to users of video-editing software. Another class of popular effects are filters. Filters radically change the appearance of the on-screen images. One filter will make an image look like a mosaic, for instance, while another filter will make the image look like an Impressionist painting. Some filters affect the color scheme, for example, by reversing light and dark colors or exaggerating contrasts, while others alter shapes, for example, by blurring fine borders or creating a mirror image of everything that appears on-screen.

Most editing applications provide filters, but consumer-oriented editors, such as Ulead VideoStudio ($99.95, http://www.ulead.com) and MAGIX video deLuxe, will typically provide the widest assortment of filtering options. The reason is simple: Amateurs are more likely to use them than professionals are. Indeed, you should use filters sparingly, if at all. You should only insert filters into the timeline as an effect on a specific clip or image.

Text. A third class in the category of special effects involves the use of text within a video. Regardless of whether you use text for an

opening title or the closing credits, text effects can have a major impact on your project. Text effects can be animated (when they move across the screen in some way) or static (when they don't move). Use animated text for credits and titles, as well as any time you want to draw special attention to the words that appear on-screen. Stick with static text for captioning.

Most video-editing applications let you insert text directly over the existing video tracks, either as an effect on a specific clip or as a separate track. These applications also provide multiple options for configuring the text. You get to select the font, size, style, and color of the text; the direction the text travels across the screen; and the length of time the text remains on-screen. Advanced programs typically offer a few more options, including the ability to configure the spacing and alignment of the characters; reshape the text; and add shadows, borders, and other effects to the text.



The timeline is the canvas on which you create your video project. This is where you insert effects, synchronize audio and video tracks, and build a movie that makes sense.

Sound, narration, and background music. The days of silent movies have long passed. Modern video projects contain several audio tracks. First, there's the natural sounds—people talking, birds chirping, leaves rustling, and the like—that are captured along with the footage. This is the most important audio track in your project because it provides a lot of information about the clips that appear on-screen.

When you import a video clip into your project, the editing application preserves the sound either as an integral part of the video clip, as is the case with Ulead VideoStudio and other consumer-oriented programs, or as a separate track, just as Adobe Premiere and other professional-grade programs do.

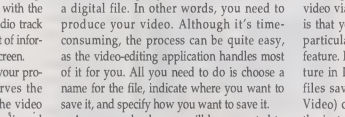
Second, you have the option of adding voice-over narration. You should use narration to explain particular clips or still images that may be confusing to the viewer. You also may use narration in conjunction with a transition as a way to tie together disparate clips.

To record voice-over narration, you need a microphone and a sound card that supports audio recording (almost all do). Depending on which video-editing program you use, you either prerecord the narration and save it as an audio file you import into the program's multimedia library or record the narration within the program while previewing the corresponding video clip. Obviously, the second option is preferable because it lets you synchronize the narration with the action in the video. The best editing programs, including Adobe Premiere and Ulead VideoStudio, support this option.

Third, you may have the option of inserting background music. Use background music whenever you want to set a mood or mask the natural sounds of the video clip. The background music is typically imported into the program as an audio file and then inserted into an available audio track. Programs that offer only one audio track may not be able to accommodate background music and voice-over narration, so you may have to choose one or the other.

Produce a file. After arranging the clips, laying the tracks, and rendering the effects, it's time to compile your multimedia data into a digital file. In other words, you need to produce your video. Although it's time-consuming, the process can be quite easy, as the video-editing application handles most of it for you. All you need to do is choose a name for the file, indicate where you want to save it, and specify how you want to save it.

As a general rule, you will be prompted to select a file format, such as AVI (Audio-Video Interleaved), MPEG (Moving Picture Experts Group), or WMV (Windows Media Video); a frame rate, typically between 15fps (frames per second) and 30fps; and a frame size or resolution, such as 360 x 240. You also may be asked for a dpi (dots per inch) setting, an aspect ratio (4:3 is common), and audio recording settings. Some consumer-oriented programs combine these settings into a handful of one-click options to make it easy for you. Windows Movie Maker, for instance, gives you the chance to pick a low-, medium-, or high-quality setting. The particular options a program provides and the exact procedure for selecting them will differ from one program to the next.



Layering video clips, graphics, and audio files on multiple tracks helps build a content-rich production. Here, from top to bottom, we layered content with two video tracks, a title track, a narration track, and a background music track.

You can view your produced digital videos through any multimedia player that supports the selected file format. Windows Media Player, which comes free with the latest versions of Windows, can display most popular video formats. You will need a specialty viewer, such as Apple's QuickTime (free; http://www.apple.com/quicktime) or RealNetworks' RealOne Player (free; http://www.real.com), to view proprietary video formats.

Distribution. For many users, the editing process is not complete until they distribute their digital video productions to their intended audiences. Common distribution models include rewriteable/recordable CDs or DVDs, email, and the Web. The latter two options are the easiest because every video-editing application boasts some sort of online publishing feature for distributing video via electronic channels. The only hitch is that you may have to save your files in a particular format to take advantage of the feature. For example, the Publish To Web feature in Roxio VideoWave only works with files saved in the WMV (Windows Media Video) or RM (RealMedia) formats. Check the instruction manual that came with your video-editing application for more details about how to use the online publishing feature.

Recording a video file to a rewriteable/recordable CD or DVD is equally easy, although the steps vary depending on whether you intend for another computer or standalone DVD player to access the disc. As long as you plan to view the file on a PC, you usually can save it directly to the disc drive during production. If you want to view the file on a DVD player, however, you must ensure that the file is produced in the MPEG-1 or MPEG-2 format. Users who plan to do a lot of burning (writing data to disc) should get an editing application, such as Ulead VideoStudio or Pinnacle Studio Deluxe ($299.99; http://www.pinnaclesys.com), that has built-in functionality especially for that purpose.

You also have the option of outputting your files to an analog or digital videotape, such as a VHS videocassette or a Digital8 tape, but these options can be quite complicated. For example, you must have a video card that supports output to the appropriate device, such as a VCR or digital camcorder. You also must have software that supports the transmission. Most advanced editing applications can handle output to a digital video device, but you may need to use the proprietary software that comes with your video capture card if you want to output to an analog device. In any case, follow the directions the users manual provides to make the switch.

■ **It's Entertainment.** When all is said and done, perhaps the most important lesson you can learn about digital video editing is that it should be fun. Don't let procedures and rules bog you down. Take the time to explore your digital video-editing application and sample all the nifty effects it has to offer. Remember, it's all about entertainment. LS

by Jeff Dodd

Our Video Editor Choices

The video-editing software you choose to use limits so much of the digital movie making process. Even if you have an abundance of quality footage and a rich imagination, you cannot work around the technical limitations of an underdeveloped application. Similarly, you will not accomplish much by using a program that is too advanced for your skills. The complex functionality—not to mention the price—may prove too much for all but the most ambitious editing greenhorns.

The trick, then, is finding a program you feel comfortable using. One that provides all of the desired features and capabilities without making you work too hard to use them. Fortunately, the digital video-editing market has a wide array of products suited for every skill level and budget. Here are the ones we call the best.

5. Windows Movie Maker. Every future Steven Spielberg has to start somewhere, and Windows Movie Maker from Microsoft is as good a place as any. This simple program has limited functionality but is by far the easiest editing application to learn. You can use it to produce a video in less time than it takes to install some of the other editing applications on our list. Plus, you can get it for free with the latest versions of the Windows OS (operating system).

4. Avid Xpress DV. At the other end of the spectrum is Avid Xpress DV (http://www.avid.com), a professional-grade editing tool that anyone can have if they're willing to shell out $1,699 for the privilege. That sort of money buys you everything you need to produce a video that would fit right in with anything you see on television or in the theater. A powerful product, but it's overkill for most users.

3. Pinnacle Studio. Pinnacle Systems (http://www.pinnaclesys.com) has eight Emmy Awards for outstanding engineering achievement. The award-winning technology has filtered into the company's popular video-editing software, Pinnacle Studio (version 7). This consumer-oriented package sells for $99.99 and offers a wide assortment of popular features and functions. For greater functionality, upgrade to Studio DV or Studio AV, which come bundled with video capture cards that support output to digital and analog sources, respectively.

2. Adobe Premiere. The biggest name in video-editing software comes from the biggest name in multimedia: Adobe Systems (http://www.adobe.com). Although it's a bit too advanced for novice editors, Premiere manages to put a complete set of professional-grade tools in an interface that an enthusiastic amateur can easily master. This is the video-editing application of choice for many people, but its price—$549—puts it beyond the budget of most home and small office computer users.

1. Ulead VideoStudio. *Editors' Choice.* The best of the consumer-oriented video editors, Ulead VideoStudio (http://www.ulead.com) is packed full of features, including built-in DVD ripping functionality and the ability to communicate with IEEE 1394 (often referred to as FireWire) devices. Its interface, with eight separate but equally intuitive pages for each facet of the editing process, makes it a breeze to learn. Best of all, it's priced at less than $100.

	Windows Movie Maker	Avid Xpress DV	Pinnacle Studio	Adobe Premiere	Ulead VideoStudio
Number of audio tracks	1	4	5	99	2
Number of video tracks	1	8	3	99	3
Audio effects	no	yes	yes	yes	yes
Video effects	no	yes	yes	yes	yes
Transition effects	no	yes	yes	yes	yes
Text effects	no	yes	yes	yes	yes
Web output	yes	yes	yes	yes	yes
Streaming video output	no	yes	yes	yes	yes
DVD authoring	no	yes	no	no	yes
Recommended processor	400MHz	750MHz	600MHz	700MHz	700MHz
Recommended RAM	128MB	256MB	128MB	128MB	128MB
Price	free	$1,699	$99.99	$549	$99.95

Video Editing, Step By Step

Making Tracks To Roll Out A Top-Notch Project

Believe it or not, the average home movie has much in common with the average Hollywood bomb. Like your amateur footage of Christmas morning or the company picnic, films such as "Ishtar," "Freddy Got Fingered," and everything Kevin Costner has made in the last 11 years have unintelligible plots, poor acting, awkward dialogue, and annoying background music. Indeed, one might argue that the only distinguishable differences between a home movie and a forgettable flick are famous actors and professional editing. Even the worst cinematic calamity spent hours in the hands of film editors. These trained specialists are paid to compile reels of footage into polished productions the general public will pay to see.

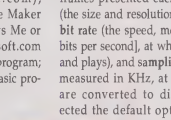
You may not get anyone to pay to see your videos, but you can make them look like real movies. We'll acquaint you with the process, one step at a time, using Ulead VideoStudio 6.0 ($99.95, http://www.ulead.com). This consumer-oriented program combines an intuitive interface with a wide assortment of robust editing tools. It's hard to find a better deal for the money in today's video-editing market. That's why we selected it as our Editor's Choice.

Of course, any video-editing application will suffice. The important thing is not whether you use Ulead VideoStudio, Adobe Premiere ($549, http://www.adobe.com), Windows Movie Maker (free with Windows Me or Windows XP; http://www.microsoft.com/windows), or some other popular program; rather, it's how well you grasp the basic procedures involved in video editing.

Step 1: Open A Project.

The natural place to begin is by opening your video-editing application and launching a new project. Not only does this serve as a formal starting point, but it also establishes the underlying audio and video settings that will govern your work.

You must have a video-editing application if you want to edit digital video on your PC. We chose Ulead VideoStudio 6.0 for its rich functionality and ease of use. You can use any editing application you prefer.



To launch a new project in VideoStudio, we opened the program to its Start interface. (VideoStudio is divided into eight separate interfaces—Start, Capture, Storyboard, Effect, Overlay, Title, Audio, and Finish—that contain the appropriate controls and settings for the different stages of a project.) We clicked the New Project icon and were immediately prompted to provide two pieces of information.

First, we had to identify the folder in which VideoStudio would save our work. We chose the My Documents folder on the hard drive, but we could have selected any location on the PC or network. Next, we had to specify a template for our project. The template is a collection of key video and audio settings, including the **frame rate** (the number of video frames presented each second), **frame** size (the size and resolution of the video frames), **bit rate** (the speed, measured in Kbps [kilobits per second], at which audio data records and plays), and **sampling rate** (the frequency, measured in KHz, at which analog sounds are converted to digital data). We selected the default option because it offered everything we wanted: a frame rate of 29.97fps (frames per second), an adequate frame size of 352 x 240, a bit rate of 224Kbps, and a CD-quality sampling rate of 44.1KHz. After we made our selections, VideoStudio automatically switched to its Capture interface for the next step in the process.

Please note that this first step varies widely with each application. In fact, some consumer-oriented programs, such as Windows Movie Maker and Roxio VideoWave ($99.95, http://www.roxio.com), do not let you specify

audio and video settings until you actually produce the video (see Step 9). Refer to your users manual for information about how to launch a new project and when to configure the audio and video settings.

Step 2: Gather The Content. Next, you need to gather the multimedia content you will use within the project. The content should be stored as digital files on your computer system or network. If the content exists in analog or hard-copy format, you must bring it into your system. See "Grab That Video" on page 58 for a detailed explanation of how to capture multimedia content.

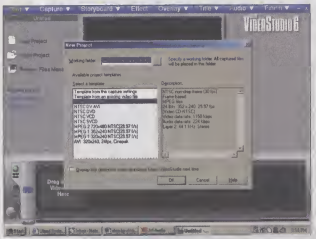
When you have the multimedia files on your system, it's time to import them into the editing application's content library. The library is a collection of links to the content you plan to use in your project. Most applications divide the library into several sections. The VideoStudio library, for instance, provides separate folders for video, images, and audio content, as well as customizable folders you can create to hold any content you choose.

To import a video clip into the VideoStudio library, we opened the Video folder and selected the Load Video icon. The Open Video File dialog box appeared on-screen. We located the file on our computer system and clicked the Open button to import it into the library. A link to the selected file then appeared in the Video folder. We repeated this process to import several video and graphics files into the Video and Images folders.

While we were building our library, we decided to create an Image-Family Photos folder to hold digital images of close family members. To create the folder, we opened the library's drop-down menu and selected Library Manager. In the resulting dialog box, we chose the Image folder from the Available Custom Folder field and clicked the New button. We typed **Family Photos** when prompted to enter a folder name and then clicked OK. The new folder appeared immediately in the Library Manager.

Step 3: Lay Out The Content. Perhaps the most important step in the whole editing process is when you lay out your content. The procedure is the same for virtually all video-editing programs: You simply drag the selected content from the library and drop it into the program's storyboard.

The **storyboard** is a linear workspace on which you arrange your clips and images in the order in which you want to present them. The clips and images that come at the beginning of the video go on the left, those that come at the end of the video go on the right, and everything else lines up sequentially in the middle. The storyboard in VideoStudio resides at the bottom of the editing window, where it shares space with the timeline (see Step 4 for information about the timeline). Refer to your users manual for details about accessing the storyboard in your video-editing application.



The creation of a new editing project is a logical starting point and an ideal place to establish the parameters for your work. VideoStudio simplifies the process by presenting a variety of preconfigured templates in the New Project dialog box.

The storyboard serves as the working space where you lay out your project in a logical order. Feel free to spend plenty of time arranging the content in the desired order. If you do it right, the rest of the process will flow quite smoothly.

If the process of moving content from the library to the storyboard is easy, the process of arranging the content in a logical order is not. Oh, the physical act of arranging the content is simple enough: You just drag the clips from one spot to the next until you're satisfied with the order. The difficulty comes in settling on the clip sequence. The sequence is crucial in determining how you tell the story, what the plot is, which clips and images you use and which you abandon, and whether you need to get more content to make the movie complete. You need to spend some time really thinking about how you want to present the clips and images in your video.

As a rule, every video needs three parts: an introduction, a body, and a conclusion. The introduction should grab the attention of the audience, the conclusion should provide a resolution to the action, and all of the content should be arranged in a logical sequence. In most cases, this means a chronological ordering of the content. Event videos, which cover everything from bar mitzvahs and Christmas mornings to vacations and long weekends, work best when presented in chronological order. Another type of logical sequence is a topical ordering, by which the contents are organized by subject. School projects and business presentations are typically presented in this way. Amateur movies and plays may utilize creative sequencing based on plot or characters, but these should still maintain a logical structure that the audience can follow and understand.

By the way, don't forget to include digital photos in your layout. Digital photos and other graphics break up the endless monotony of video footage and add another layer of substance to your project.

Step 4: Trim The Clips. You've done a fair amount of work so far, so this is an appropriate time to save your project. Most video-editing programs provide a Save command, either on one of the drop-down menus or as an icon on the interface. In VideoStudio, we clicked the Save Project icon to open the Save As dialog box. We specified a location to save our project and gave it a name. Upon clicking the Save button, our project file was created. From this point on, we made a special effort to save the project periodically in order to protect our work.

Step 4 involves trimming the clips by removing extraneous footage from the beginning and ending of each clip. The important thing is to exercise prudence when making cuts. Trim only what is necessary, and make several small cuts instead of one large cut. You just want to eliminate the awkward moments that invariably mark the beginning and end of every video clip.

You can make the cuts by accessing the timeline. The timeline is essentially a detailed version of the storyboard. It tells you the duration of each clip and gives you access to the individual frames within each clip. The storyline also lists the various tracks (streams of content; video may be one track, for instance, while background music is another and voice-over narration is a third track) that will make up your finished video.

To trim a clip in VideoStudio, we opened the timeline and selected a lengthy clip. The duration of the clip appeared in the Duration field, which is located in VideoStudio's Options Panel to the left of the Preview Window. We then previewed the clip in the Preview Window to determine where we wanted to trim it. As we watched, we made a note of where the relevant footage began and ended. Now we were ready to make our cuts.

VideoStudio provided several trimming options; we chose to use the Trim Bar. This bar has two handles, one on each end, that control the starting and ending position of the clip. As we moved each handle, a corresponding timer showed how much footage we were cutting from the clip. We positioned the trim handles so they framed the relevant footage, and then clicked Apply to chop away the excess. We repeated the process for each of the 14 clips that made up our video.

Step 5: Add Video Effects. This is an appropriate time to add video effects to your clips (we'll add transitions and text effects later). Video effects let you embellish your project with technical illusions. We recommend that you go easy with them because too many—and even two may be too many, depending on your project—can turn your would-be masterpiece into a gaudy annoyance. As a rule of thumb, you should use a video effect only when the situation warrants it.

We decided to add a filter to a couple of video clips in our project. To add the effect, we opened the Storyboard interface and selected a clip from the storyboard. Next, we opened the library menu and highlighted the Video Filter folder. This folder contains 30 filters and visual effects, such as Blur, Emboss, Mosaic, and Zoom Motion. Most video-editing applications offer a similar number of video effects. We selected the Cropping filter, as it would draw the viewer's attention to a particular area of the screen. The Options Panel presented several preset variations of the filter, and we selected one. Then we clicked the Options button to fine-tune the filter. In the case of the Cropping filter, we were able to adjust the size of the cropped area and select a fill color. We saved our options and clicked Apply to save the effect to the clip.

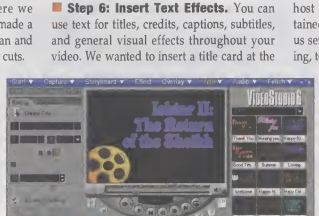
In most cases, you can add video effects to still images, as well as video clips.

Step 6: Insert Text Effects. You can use text for titles, credits, captions, subtitles, and general visual effects throughout your video. We wanted to insert a title card at the beginning of our project, rolling credits at the end, and a handful of captions throughout. Fortunately, the process for inserting text was the same each time.

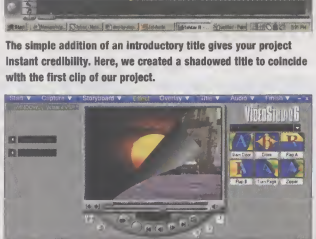
We started by opening VideoStudio's Title interface. The Title interface provided the tools we needed to do the job correctly. One of these tools is a library of effects. We selected a title effect from the library, but it really didn't matter which effect we chose because VideoStudio gave us the option of changing everything about it. And when the default text appeared in the Preview window, we replaced the default text with the words and phrases we wanted to use.

Next, we customized the text using the host of editing and animation options contained in the Options Panel. The options let us set the font, font style, font size, line spacing, text position, duration, border, and shadow. We also were able to animate the text so it fades in or out, flies across the screen, or zooms in and out of perspective. We configured the text effect to meet our needs and preferences, and then clicked Apply to save it to the effects catalog.

Finally, we dragged the customized text effect to the appropriate position on the timeline's Title Track (not all programs have a separate title track; refer to your users manual for specific instructions), and then previewed the text effect with its accompanying footage. Satisfied with the results, we repeated the process for each text effect we wanted to incorporate into the project.



The simple addition of an introductory title gives your project instant credibility. Here, we created a shadowed title to coincide with the first clip of our project.



Transitions, such as this one that peels away one clip to reveal its successor, are fun to play with. Just make sure you keep their presence to a minimum in your video.

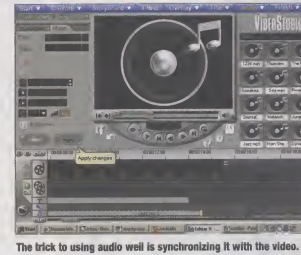
Step 7: Insert Transitions. When people first get their hands on video-editing software, they tend to overdo it on transitions. We encourage moderation in this area. The best bet is to trim your clips strategically so you can use straight cuts between most scenes, then use transitions for the rare instance when a straight cut just won't work. We decided to use transitions only when a video clip bumped into a still photo. A quick and subtle transition in this type of situation softens the switch from motion video to still image.

Most video-editing applications make it very easy to insert transitions. VideoStudio is no exception. We

opened the Effects interface to access the transitions library, which consisted of 12 folders with approximately five to 15 transitions each. After perusing the library, we clicked a Flying Box transition to select it. Immediately, a list of options—tailored specifically for that transition—appeared in the Options Panel. We reviewed the options, which included a clock for adjusting the duration and buttons to change the direction of the transition, and made changes accordingly.

From this point, inserting the transition into our video project took only two clicks of the mouse. We clicked the Add button and then clicked the timeline at the point where we wanted to insert the transition. The transition appeared on the Video Track Timeline as a yellow box straddling the content before and after it.

Note that you should design your transitions to complement the flow of action in the surrounding clips. For example, if a clip ends with a character walking off-screen to the left, then you should use a slide transition that follows the character across the screen from right to left. Instead of using a lot of transitions, make sure the ones you do use are of high quality.



The trick to using audio well is synchronizing it with the video. In this project, we trimmed the background music so that it fades out at the end of the introductory title, and then we clicked Apply to make the trim a permanent part of our project.

■ **Step 8: Add Voice-Over Narration & Background Music.** It doesn't matter when or in what order you add voice-over narration and background music to your video, but we suggest waiting until your project is in its final stages. Synchronizing audio tracks to the rest of your project is a tedious task and one that is best accomplished when you know the graphical content of your project will not change.

The number of tracks available to you in your video-editing program limits your audio options. VideoStudio, like the majority of video-editing programs, includes separate audio tracks for voice-over narration and background music. If your editing application supports only one audio track, you must choose between adding voice-over narration or background music. You cannot do both.

We opted to record the voice-over narration first. Before we did that, however, we reviewed the video to determine where we wanted the narration to begin and how long it had to be. We also took a few minutes to prepare a simple script. A script can help you formulate what you want to say in the amount of time you need to say it. Don't underestimate the value of using one.

Next, we checked the narration recording settings, which are located under the Voiceover heading in the Options Panel. We set the Recording Duration field for the length of the recording and then activated the Record With Preview option so we could watch the corresponding footage while we narrated. Then, with script in hand and video cued to the relevant footage, we clicked the Record command and recorded our narration. We repeated the process for each of the voice-overs we wished to record.

The steps for adding music are similar. VideoStudio gave us the option of using audio files or CD tracks. We wanted to use music from a CD, so we inserted the disc into the disc drive. The contents of the disc appeared in the Disc and Track fields under the Music heading in the Options Panel. We selected the track we wanted to record, cued the timeline to the point where we wanted the background music to begin, and then clicked the Record button. At the end of the song, we clicked the Record button again to end the recording.

After adding all of the audio content to the timeline, we used the VideoStudio editing options to adjust the volume for each audio clip, trim each audio clip down to size, and reposition the audio clips as needed.

■ **Step 9: Review & Produce.** You've laid the tracks and inserted the effects. Now it's time to review your work. The review gives you a chance to see how everything fits together and determine whether you need to make any adjustments. Make sure you watch the video all the way through at least once before starting your final edits. This gives you a chance to identify the weakest sections of the video and make changes accordingly.

When a project finally meets your exacting standards, save it one last time and get ready to produce it. This is when the video-editing application actually compiles the various clips into one complete movie and then either saves the production on your system, writes it to digital storage media, outputs it to videotape, or records it in some other acceptable format. Fortunately, the software handles most of the work. All you have to do is activate the appropriate command.

VideoStudio, like most editing programs, offers several production options. We had the option of creating a DVD or exporting our production to the Web, but we chose to save it as an MPEG (Moving Picture Experts Group) file on our hard drive.

To initiate the process, we opened the Finish interface and selected the Create Video File option. We then gave the production a name and indicated where we wanted to save it. We also chose the .MPG file extension and format (the file formats offered to you may vary depending on which template you selected when creating your project in Step 1). After we clicked Save, VideoStudio began the process of rendering the project into the video format. The rendering time will vary depending on the complexity of your video and the technical specifications of your PC.

■ **Step 10: Sit Back & Enjoy.** Don't kid yourself. Digital video-editing technology has a lot to offer, but it can't compensate for a lack of talent. It takes artistic vision, creative genius, technical wizardry, and years of experience to create movie masterpieces such as "The Godfather," "Citizen Kane," and "Schindler's List." A $100 software package and state-of-the-art PC isn't enough.

Nevertheless, following the steps outlined above, you can create a home movie your family and friends will beg to see again and again. So pop the popcorn, pour the sodas, and turn down the lights. Who would have thought home movies could be so fun? LS

by Jeff Dodd

Memorable Media

Create A Multimedia Presentation Featuring Photos, Video & More

If you're like a lot of people, you have wonderful intentions of organizing your photos and memories in scrapbooks. Perhaps you even dream about creating an album for each of your children and have invested a considerable sum in acid-free photo albums, stickers, and markers. But when it comes down to it, you probably found that you simply don't have time to organize all those baby and beach pictures sitting in boxes in the closet.

Or perhaps this sounds familiar: You're at work and your boss has suddenly asked you to put together a whiz-bang presentation for tomorrow's meeting—complete with all the multimedia bells and whistles you can muster. If only you could remember how to put all those elements in place. . . .

Don't fret. Instead of creating traditional paper and photo albums (or old-fashioned transparency presentations), you can pair up multimedia software and your digital camera to develop top-notch multimedia presentations and electronic albums. Electronic albums and presentations have several advantages over their time-honored siblings: Multimedia presentations (including digital albums) are quick and easy to create, they allow for cropping and modifying the images, and you can use a variety of backgrounds, layouts, animations, and sounds.

Digital albums are typically less expensive than conventional ones, too. Once you incur the upfront costs of buying the digital camera and multimedia software, the number of albums you can develop is limited only by disk or hard drive storage space. Furthermore, you can experiment freely by using different lighting and setups without worrying about wasting film.

Finally, you can easily share your photos with friends and family via email, your Web site, or a CD—getting those latest pictures of your daughter's first birthday party into her grandparents' hands *before* she heads off to college.

Compared to just a short while ago, you can use a variety of multimedia tools and programs to create your presentations, too. Not only are some applications specifically designed to create and edit multimedia objects, a number of mainstay programs routinely include multimedia features, as well.

In this article, we'll show you how to use one of the most popular presentations programs, Microsoft PowerPoint (part of the Microsoft Office XP suite, $239 for Standard version; $339 to purchase PowerPoint 2002 separately; http://www.microsoft.com/office/powerpoint), to create a multimedia presentation. As we do so, you'll learn how to insert digital images, animations, and sound into the presentation. We'll also take a peek at FlipAlbum Suite 4.0 from E-Book Systems ($49.95, http://www.flipalbum.com), an easy-to-use program that creates digital albums with a look similar to a traditional paper-and-film photo album. In addition, we'll refer you to other editing tools and software you can buy if you want to expand your options and skills.

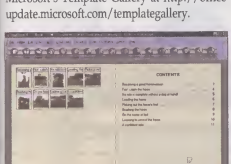
If you already know the basics of working with PowerPoint 2002, you'll probably find it easy to learn its multimedia features. To give you some examples of items you might include in a presentation, we'll walk you through the process of developing a multimedia presentation step-by-step.

■ **Set Up The Design.** You can begin your multimedia presentation with an existing file or develop one from scratch. Either way, it's helpful to decide the template design, including the background colors and clip art, before you get too far along. This is useful because it helps you see how the inserted photos and art look in combination with the presentation's design.

To select a design, choose Format, Slide Design from the menu. In the displayed Slide Design task pane, scroll through the list of

available templates. To apply a template to your presentation slides, click it in the task pane. Don't like the look? Just apply a different template. When you finish, close the task pane.

You can also find additional designs in Microsoft's Template Gallery at http://office update.microsoft.com/templategallery.



Use E-Book Systems' FlipAlbum to create a digital photo album, complete with a table of contents.

■ **Choose A Layout.** Each presentation slide includes a specific layout, with preset areas (placeholders) for inserting text or multimedia elements. And even though you can almost always insert the same multimedia elements via menu commands, it's usually easier to pick a slide layout that already includes a placeholder for the object.

For example, if you want to insert a video, you can choose the Title and Content layout, which includes icons for the most commonly inserted multimedia objects. When you click the appropriate icon on the slide, PowerPoint automatically inserts the correct object. But even if you don't choose a Content layout, you can still insert multimedia objects—you'll just need to use the menu commands to do so.

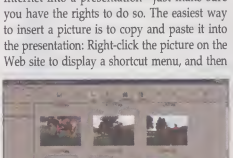
To choose a layout for a slide, display it in Normal view and then choose Format, Slide Layout. In the displayed Slide Layout task pane, rest your mouse pointer over each layout to see which placeholders each layout includes. When you find the arrangement you want, click it to apply the layout to the current slide.

■ **Find Photos To Use.** After you initially decide on the design template and layout you want to use, you're ready to add some visual interest. Let's start with photographs. PowerPoint, like most presentations programs, includes commands so you can insert pictures from a digital camera, a folder on your computer, a scanner, or even from the Internet. Here's how.

First, display the slide in Normal view and choose the layout for the slide. If you choose the Title Only or Blank layouts, you'll have plenty of room on the slide to insert photographs or other visual elements. Depending on how your system is set up, you have various options for inserting a digital picture into your presentation. If the photograph already exists on your computer as a file, you can choose Insert, Picture, From File. In the Insert Picture dialog box, click the image you want and then choose Insert.

Alternately, you can click the Insert button's drop-down menu arrow and choose Link To File. This results in a slim and trim PowerPoint file by creating a connection to the original picture instead of actually saving it as part of the presentation.

You can also insert pictures from the Internet into a presentation—just make sure you have the rights to do so. The easiest way to insert a picture is to copy and paste it into the presentation: Right-click the picture on the Web site to display a shortcut menu, and then



Depending on the software your camera or scanner uses, you may be able to drag and drop images directly into Microsoft PowerPoint.

choose Copy. Click the slide where you want to place the image and then choose Paste.

Another alternative for getting pictures into a multimedia presentation is to take the photo directly from a digital camera or scanner into your presentation. PowerPoint also makes this process easy. Just choose Insert, Picture, From Scanner Or Camera. In the Insert Picture From Scanner Or Camera dialog box, select the input device where the picture is located and click Custom Insert.

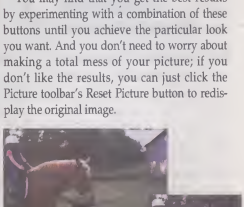
PowerPoint will access the software your camera or scanner uses and display the associated pictures. You can drag a picture from the software's display to the PowerPoint icon and then drop it to insert it on the current slide. Or the software may prompt you to download pictures still in your camera before you can insert them into the presentation.

After you place photos in a slide, you can modify them in a variety of ways so they look better. And although you can edit photos with a wide variety of software, such as Microsoft Photo Editor, you can also use the photo-editing tools available within the Microsoft Office suite. To adjust the picture within PowerPoint, for example, click the photo to select it and display the Picture toolbar. (If the toolbar doesn't automatically display when you select the picture, choose View, Toolbars, Picture from the menu.)

After it displays, you can use the buttons on the Picture toolbar to revise the photo. For instance, you may need to adjust the color balance or intensity. Here's how: To increase or decrease the amount of white (brightness) of the image, click the More Brightness or Less Brightness buttons. To change the amount of gray vs. saturated colors, click the More Contrast or Less Contrast buttons. You can also change the photo to shades of gray by clicking the Color button and choosing Grayscale on the drop-down menu.

Additionally, you can crop out distracting portions of the photo, such as too much sky in the background, with PowerPoint's Crop tool. Click the Crop button to place cropping handles around the border of the picture, and then drag a handle to eliminate the part of the picture you don't want.

You may find that you get the best results by experimenting with a combination of these buttons until you achieve the particular look you want. And you don't need to worry about making a total mess of your picture; if you don't like the results, you can just click the Picture toolbar's Reset Picture button to redisplay the original image.

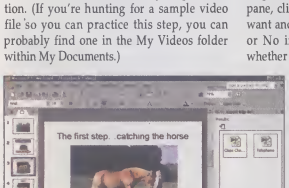


Focus your message. Use Microsoft Office's built-in tools to crop unnecessary or distracting backgrounds.

■ **Insert A Video.** PowerPoint also includes a feature you can use to seamlessly insert videos (which PowerPoint refers to as movies) into your presentation. Business presentations typically use videos to illustrate a process or products. Of course, they're also

perfect to use in personal presentations when you want to share Junior's first steps with his grandparents, too.

You have two main ways to insert a video: From an existing file or from the Clip Organizer, PowerPoint's repository of animations and other clips. For example, you might have an existing video file on your computer of your child hitting a home run at last week's Little League game. To insert a video file on a PowerPoint slide, display the slide in Normal view, and then choose Insert, Movies And Sounds, Movie From File. In the Insert Movie dialog box, navigate to the folder where your movies are stored, then double-click the file to insert it in your presentation. (If you're hunting for a sample video file so you can practice this step, you can probably find one in the My Videos folder within My Documents.)



The Clip Organizer included with Microsoft PowerPoint has prerecorded sounds for you to choose from.

When you insert a movie (or sound), PowerPoint automatically displays a message box, asking if you want to play the movie when the slide displays in an electronic slide show. Choose Yes if you want to set this option; choose No if you want the video to play only when you click the object.

If you want to access videos that are in the Clip Organizer, you can choose Insert, Movies And Sounds, Movie From Clip Organizer. From the task pane, double-click the clip you want to place in your presentation. As usual, you can resize a selected movie object by dragging a sizing handle; move it by dragging the selected object, or completely remove it from the presentation by pressing DELETE.

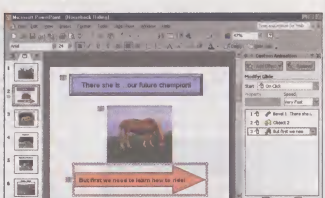
■ **Play It Again, Sam.** No multimedia presentation would be complete without sound to accompany it. You can use PowerPoint to add any music files you want, from classical to rock. You can also punctuate your points with sound effects (such as applause for a little comedy relief) or even record a customized message.

To find any sound clips located in the Clip Organizer, choose Insert, Movies And Sounds, and Sound From Clip Organizer. In the task pane, click the sound you want and then choose Yes or No in the message box to determine whether the sound should automatically play during a running slide show. You'll also notice that the sound object inserts in the middle of a slide. Because of this, you'll probably want to drag it to an out-of-the-way location on the slide.

If you want to listen to the inserted sound effect before actually using it in a slide show, display the slide in Normal view and then double-click the sound object. You can also modify the settings so the sound plays continually until you advance to the next slide. To do this, right-click the sound object and choose Edit Sound Object on the shortcut menu. Select the Loop Until Stopped checkbox and then click OK.

As another option for using sound in your multimedia presentation, you can play a prerecorded CD as background music. Choose Insert, Movies And Sounds, Play CD Audio Track. Alternately, record your own custom narration by choosing Record Sound on the Insert, Movies And Sounds submenu.

Finally, if you want additional choices for multimedia elements, such as photos, movies, animations, and sounds, take a quick trip to the Web. In fact, PowerPoint includes an easy-to-use gateway to Microsoft's Design Gallery Live so you can tap into a multitude of multimedia objects. To download clips from this Web site, click the Insert Clip Art button on the Drawing toolbar to display the Clip Art task pane. Click the Clips Online button at the bottom of the task pane to access (and download clips from) the Design Gallery Live.



You can add customized animation effects to your PowerPoint slide objects, but be careful not to overdo it.

■ **Slide Transitions With Style.** Now you're ready to add even more pizzazz to your presentation. How? By changing the way one slide replaces another with slide transitions. These multimedia effects add interest to your presentation and help your audience focus on the message, but don't overdo it because too much pizzazz can become annoying rather quickly.

To insert a slide transition, select the slide in Normal (or Slide Sorter) view, and then choose Slide Show, Slide Transition. In the Slide Transition task pane, click the AutoPreview checkbox at the bottom of the task pane. Next, click an effect on the Apply To Selected Slides list. This plays the transition and simultaneously applies it to the selected slide. If you really like the effect (and it's not too bold or distracting), you can quickly add it to all presentation slides by clicking the Apply To All Slides button at the bottom of the task pane.

After you initially set a slide transition, you can modify how quickly it appears. To do this, choose from the options in the Speed drop-down menu.

Next, to add sound to the slide transition, click the Sound drop-down arrow and choose an audio effect.

■ **Add Animations.** You can also add customized animations so a slide's objects appear in a specific order. This helps you control the flow of information and adds interest to the presentation (again, if you don't overdo it). For example, you direct bulleted points to "fly"

on-screen, one at a time, from the lower-left corner of the slide.

To insert customized animation, choose Slide Show and Custom Animation to display the Custom Animation task pane. Select the slide object to animate and then click the Add Effect button. Point to Entrance, Emphasis, or Exit, depending on when you want the animation to play, and then choose an effect from the submenu. If you click the AutoPreview checkbox at the bottom of the Custom Animation task pane, the animation will play when you choose it.

Use WordArt objects from PowerPoint's WordArt Gallery to create snazzy titles on introductory or featured slides.

The effects you add appear in the Custom Animation task pane, and a numbered animation icon appears by the associated object. This icon indicates the order that the animations will play. You can change the animation order by clicking and dragging the effect up or down within the list in the Custom Animation task pane. Or you can click the effect in the list and then click the Up or Down Re-Order buttons. To preview the entire sequence, click the Play button in the task pane.

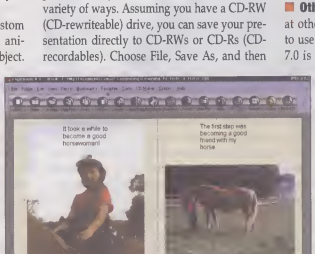
You can further modify the animation by changing the speed, direction, or other properties. To change the animation speed or direction, select the effect in the Custom Animation task pane, and then choose an option from the Speed or Direction drop-down menus. To remove an effect, select it in the task pane and click Remove.

■ **Document Your Stuff.** You can label the visual and multimedia elements in your presentation in a variety of ways. If the slide layout includes a placeholder, you can click within it and type your information. Alternately, you can click the Text Box tool on the Drawing toolbar and then click in the slide where you want the message to appear. Next, type your information and click outside the box to "set" it in place.

You can also enter text within a PowerPoint AutoShape. These shapes come in a variety of configurations, such as arrows and banners. To create an AutoShape, click AutoShapes on the Drawing toolbar, and then choose a shape from one of the submenus. Click and drag the slide to create the AutoShape. With the shape still selected, type your text. Click outside the AutoShape when you finish.

In addition, you can use WordArt to create interesting titles or information. Click the Insert WordArt tool on the Drawing toolbar and double-click the style you want in the WordArt Gallery. In the Edit WordArt Text dialog box, type your title and click OK.

After you put the finishing touches on your presentation, you can share it with others in a variety of ways. Assuming you have a CD-RW (CD-rewriteable) drive, you can save your presentation directly to CD-RWs or CD-Rs (CD-recordables). Choose File, Save As, and then choose the CD drive from the Save In drop-down menu before clicking Save.



Creating a sequenced, organized album electronically is a convenient way to store photos.

You can also send the PowerPoint presentation as an email attachment by choosing File, Send To, Mail Recipient (As Attachment). To save the presentation for Web use, choose File, Save As Web Page.

■ **Create A Photo Album.** Of course, there are a number of other multimedia and graphics programs you can use to develop your presentations. One that helps you specifically develop an electronic photo album is FlipAlbum 4.0.

This program imitates a traditional photo album in which you insert photos on a series of 3D-looking pages. As the program's name implies, you "flip" the pages (by clicking) to view the digital photos. Because the program imitates traditional paper and film photo albums, the interface is fairly intuitive and relatively easy to learn. FlipAlbum includes features you can use to modify your photos, with the added advantage that you can also organize and categorize the images.

To streamline sharing the digital album with others, you can email it to them or export it to a CD-R. (Note that recipients can view the album [and even save photos from it] without having to install FlipAlbum.) Additionally, you can post the album to a Web site (either yours or FlipAlbum's) so your extended family across the country can view your latest creation.

■ **Other Options.** Finally, consider looking at other photo-editing software. If you want to use a high-end product, Adobe Photoshop 7.0 is well-respected and loved by graphics professionals, but also somewhat pricey ($609, http://www.adobe.com/products) and complicated for the average user. A user-friendly alternative that only costs $54.95 is Microsoft's Picture It Publishing Platinum 2002 (http://www.microsoft.com/catalog).

What is another possibility? Adobe Photoshop Elements ($99) gleans the best features from Adobe Photoshop and has a strong following among digital photography hobbyists.

Once you start creating snazzy multimedia presentations and digital photo albums, it's likely that you'll be having so much fun and getting such great results that you'll forget about the conventional systems completely. LS

by Linda Bird

Learn From The Pros

Professional Film Editing Goes Digital & So Can You

The computer revolution is akin to Midas' touch, transforming arenas such as the motion picture industry in unimaginable ways. Most moviegoers are familiar with computer-generated special effects, but many would be surprised by the dramatic impact computers have made on other aspects of feature filmmaking. One such area is film editing, where innovative software and more affordable hardware have revolutionized how movies are made.

To get a better understanding of digital video editing and its impact on feature films, we spoke with Michael Hill, a well-known film editor in the industry. With a Best Film Editing Oscar under his belt for "Apollo 13" in 1995, Hill has witnessed the transformation of the film editing industry firsthand. On hiatus after his work with Ron Howard on "A Beautiful Mind," Hill provided us with details about how film editors have embraced this technology as a means of focusing on the creative side of filmmaking.

Death Of A Thousand Splices. To an outsider, the film-editing process appears clear-cut: Simply take film footage the director and cinematographer shot and splice it together. Unfortunately, the reality of editing makes it much more laborious and requires far more creativity.

For a two-hour feature film, there might be as many as a thousand edits between scenes, as well as multiple shots from each scene. The film editor needs to evaluate each scene individually and make sure the flow between scenes fits the story the director is trying to tell. In short, editors piece together film with a sense of momentum, style, substance, and cohesion that is vastly under-appreciated.

Old School. Before the motion picture industry began migrating toward digital-editing systems, the film editing process was straightforward, though time intensive. As directors shot scenes, they would choose to print what they felt were the best takes. Assistant editors would take copies of the film printed each day (referred to as "dailies"), and synchronize them with the soundtracks. After syncing, the dailies would be broken down according to scene numbers and otherwise classified.

These working copies are what the film editors would use to "cut" a scene. Once the film met with the approval of the director and producer(s), the film editors would create a final **workprint**. From the workprint, a **negative cutter** (technician assigned to this specific task) would conform the original camera negative, the **master**, to the workprint. After conforming, a duplication copy (or copies) would be created for printing the film reels that are shipped to theaters around the world. Studios would carefully guard the conformed master copy in special storage vaults.

Although this system worked well for decades, there were some limitations. Perhaps the greatest was the requirement for film editors to have a physical copy of each scene. According to Hill, "If an editor made too many cuts, the workprint would be just a handful of frames" that couldn't be used effectively. This inhibited editors from experimenting with different compositions. An additional problem was in finding the shot or scene the film editors wanted to splice. Even with a talented assistant editor and a good organizational scheme, editors had to spend a large amount of effort to find that *perfect* shot.

Welcome To Digital School. Hill says the "big changes occurred in the '90s" as editors moved to systems such as the Avid Media Composer (http://www.avid.com/products/composer). The first movie Hill edited digitally was "Ransom" in 1996. Since then, he's never looked back.

Although digital editing has changed many aspects of filmmaking, some procedures carry over from the past. Assistant editors still need to synchronize sound on the dailies, but now two new steps are required: telecine and digitization.

Telecine. Before an editor can start working digitally on a film, he must transfer it into a video format through a process called **telecine**. Because film and video have different frame rates, the telecine process has to add six extra frames per second to compensate. The process also adjusts the image for color correction if needed. In the professional world, an accurate telecine process is vital. If the transfer isn't sharp enough, the editor won't know if the shot he's examining will look good on film. If there is any doubt, the editor must look at the original daily, which can take unnecessary time.

Digitization. The next step is converting the video image into a digital format. Assistant editors use specialized computers to digitize the scenes immediately. (Consumers have to rely on video capture cards to make this conversion, but this isn't a problem for consumers using video cameras that already record DV [digital video].) After converting the video into a digital format, it is categorized into virtual bins based on scene numbering and other conventions.

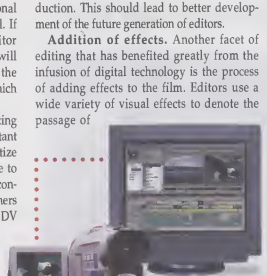
■ **The Freedom To Experiment.** Hill says digital-editing systems give editors the ability to experiment in ways that were too inconvenient before. The combination of scene virtualization and real-time effects has transformed the editing process into a more creative process than it ever was before. Combined with easier sound management, the editing process has shifted from a technical project to a creative endeavor.

Scene virtualization. When working with film, editors previously had to have a physical copy of each scene or shot. Imagine a scene composed of four shots labeled A, B, C, and D. If the editor picked ABCD as the best combination during his initial cut, he didn't face a problem. But if the editor decided to rearrange the elements so that they appeared in the order CBAD, he would have to separate each negative, resplice them together, and then view the scene. While this was tedious, the biggest problem was that the original arrangement of ABCD was gone, so the editor had to rely upon his memory to compare the two versions.

Editors working on traditional video also face this problem. Converting the shots to digital or virtual elements changes everything. By having each shot stored as a digital element, computerized editing systems, such as Avid Media Composer, let editors mix and match shots in a scene and compare different compositions. Now an editor can even prepare multiple versions of a scene for the director to choose from.

A side benefit of this is that an assistant editor can try his hand at editing a scene without worrying about causing a delay in film production. This should lead to better development of the future generation of editors.

Addition of effects. Another facet of editing that has benefited greatly from the infusion of digital technology is the process of adding effects to the film. Editors use a wide variety of visual effects to denote the passage of time and place in a film. The lexicon of fades, wipes, dissolves, and other devices of visual grammar describe effects added after completing the editing process.



As more homes adopt digital camcorders, products such as Adobe's Premiere make manipulating your videos as easy as using a word processor.

The editor would simply insert a frame into the film with the name of a desired effect, and technicians would produce the effect during negative conforming. This limited the editor and director from experimenting with alternative transitions. With professional digital-editing suites (and even many consumer-level programs), editors can create and implement these effects directly, without a delay. This lets editors see the effect and influence of each transition.

Combination of sound. Although sound editors have a profound influence on a movie, the film editor also requires some control over the audio tracks for each shot and scene. Like film, sound recordings used to be an analog media, synced up to the dailies. So, if an editor wanted to have a soundtrack overlap a scene, it required the same effort as moving film shots. With the transfer to digital editing, managing these effects became as simple as advancing the sound a few frames forward or back. This intermingling of audio tracks is seamless when done properly but jarring when done poorly.

Generating the cutlist. Once the film has been edited to the satisfaction of the director, editors, and producer(s), the software generates what is referred to as a **cutlist**. This is a scene-by-scene, frame-by-frame list of how the film and soundtrack should combine.

Armed with the cutlist, the assistant editor conforms the workprint to the cutlist, and then passes the workprint to the negative cutter. His role is to conform the master to the workprint. After he finishes this, the movie is ready for duplication and distribution to theaters.

■ **Stay Focused.** With the freedom to experiment comes a responsibility to deliver on time. Hill's experience is that "sometimes you need to reign in the urge" to tinker with something that is already working fine.

Although digital editing is the norm in Hollywood, some directors and editors continue to work with more traditional editing platforms, such as the venerable Movieola. A notable example of this is "Saving Private Ryan."

For the aspiring filmmaker, the advent of affordable hardware and software means that professional-quality editing is within reach. Avid markets Avid Xpress DV ($1,699, http://www.avid.com/products/xpressdv) with a feature set similar to its more expensive suite of tools. And the Xpress system is compatible with both Windows and Macintosh systems. Another strong contender is Apple's Final Cut Pro 3 ($999, only available for Macintosh computers; http://www.apple.com/finalcutpro), which has become the darling of the independent film community. These tools bring professional capabilities to groups and individuals who were previously unable to afford them.

Whether you are editing a wedding video, a children's play, or a documentary, the ability to perform the myriad array of post-production tasks in an affordable manner is invaluable. Just as computers have revolutionized the printing industry with desktop publishing, so, too, have computers influenced the home and consumer video industry. LS

by Chris Jackson

Trouble-Free Transitions

Video Transitions & Effects Add Polish

Working with digital video can be tricky, particularly when you have a multitude of clips you need to blend into one continuous video, or when your longer clips need some spice. In many cases, there's one surefire way to clean up such problems: transitions.

Transitions give video productions a feel of continuity, whether it's by linking separate pieces or chopping one long piece into parts to create interest or a particular mood. All modern films and TV shows use transitions to further enhance their story or message. Experienced filmmakers count on well-placed transitions to help build suspense or draw emotion from viewers. Transitions can even help build something out of what was seemingly nothing on its own—it all depends on how you use these tools to your advantage.

Although transitions are a handy part of any amateur or professional filmmaker's arsenal, they can also be a detriment if not used wisely. The wrong transition or too many transitions can easily ruin a piece that had potential. Ranging from the simple cut to more complex, graphic-rich pieces, transitions take time to master. Luckily, several video-editing programs include easy-to-use transition tools that can get you up and running in no time. In this article, we'll describe various types of transitions, where to find them, and when it's appropriate to use them.

Types Of Transitions. Upon exploring the world of transitions, you'll find a huge variety that differ in look, feel, and complexity. Although some transitions may appear to mimic the actions of others, you might find that they actually behave quite differently when applied to your video content. Also, keep in mind that even though a transition may work beautifully in the documentary you just saw on television, it might be a terrible fit for your production. Let's look at some common transitions and how they work.

Cut. The most basic type of transition is the cut. The cut creates an abrupt transition from one scene to the next by replacing the last shot of the first scene with the first shot of the subsequent scene. Although by nature the cut presents a sudden change of scenery, most film and television viewers are so used to these scene changes that they don't think twice about these transitions upon viewing them.

Blinds. In real life, vertical and horizontal window blinds expose the outside world (or a different room) when their individual parts are twisted upward or sideways. When used as transitions, blinds work the same way. Plus, you can adjust the rate at which the blinds open or close as transitions for effect.

Dissolve. This popular transition works by gradually "dissolving" the end of one clip into the beginning of another. Dissolves can be handy when you're making a time transition from one scene to another, but you don't want to show every event that occurred in between the scenes.

For example, if your video depicts a cross-country car trip, you can use dissolves to cut directly to the highlights instead of showing all of the unnecessary parts (rest stops, gas stations, etc).

Types of dissolves include additive, cross, dip to color, dither, fade in/fade out, nonadditive, random invert, and ripple. You can modify these transitions substantially, depending on your software, and reverse the direction of the dissolve, create a border, and more. You also can apply different filters to dissolves to increase their visual effect.

Fade. Similar to dissolves, the fade works by fading one scene to an interval with no picture, such as a black screen. Similarly, the reverse fade will start with an interval with no picture and fade into a scene.

Iris. Use of the iris transition was popular in silent films, but it isn't used much in modern filmmaking. This transition appears as a

shape closing in on a scene, or opening outward to the screen's edges.

Some examples of shapes used with iris transitions include crosses, diamonds, ovals, rectangles, squares, and stars. Irises tend to work best with people and animals instead of objects, especially when using shapes with more direct meaning, such as stars or hearts.

Iris transitions can be subtle or gaudy, and overuse can make a video difficult to watch. But if you use them in the proper context, they can provide smooth, timely transitions..

Special effects. Transitions with special effects can provide a high-tech look and feel to your project. For instance, a scene can burn or shatter away into the next scene. A scene also can swirl (or twirl) into the next. Or a propeller transition will spin four quarters of one scene into the next. In addition, you can use a ripple effect, or even a rolling fog, which starts on one end of the screen, overtakes the current scene, and finally reveals the new scene. The amount of transitions you can think of in this category are only limited by your imagination.

3D. Transitions don't have to be limited to 2D effects. Many programs include 3D transitions that can add a significant amount of glitz to your video. For example, a scene can fly back "into" the screen and eventually off again, revealing a new scene. This so-called flying scene can also take the shape of a variety of objects as it flies, including a ball, box, or cube.

Likewise, a scene can flip away into the background and return with a new scene as a shaped object unfolds. A scene can also turn into a set of objects shaped like doors that open inward, or perhaps become a single door that opens inward to the left, right, top, or bottom.

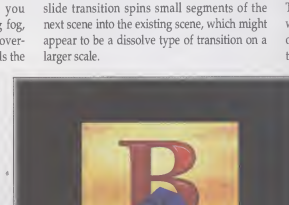
And, depending on the content of your video, you might want to use 3D effects to peel or fold the current scene into the next scene. You can implement these peeling and folding transitions as full pages or even half or quarter pages. In some cases, it might even seem appropriate to seemingly flush your scene down a drain.

Many of these 3D transitions are visually intensive, so it's a good idea to limit their use throughout your video production, unless you're purposely creating a visually packed and busy project.

Wipe and slide. Wipe and slide transitions work by sliding a new scene into the existing scene. This can happen in a variety of ways. For example, the barn door wipe splits the existing scene in two and slides the pieces to each side, revealing the next scene behind the "barn door." The barn door wipe can also close to reveal a new scene on the barn doors themselves.

And there's more. The band or strip slide splits the existing scene into thin lines and pulls them to either side of the screen to reveal the next scene. The bar slide splits the scene into a top half and bottom half, and slides those halves in opposite directions off the screen. The cross (or center-split) wipe cuts the scene into four quarters and slides them diagonally off the screen, while diagonal and push transitions slide an entirely new scene onto the screen.

Some slide transitions seem similar to dissolve transitions. For example, the multispin slide transition spins small segments of the next scene into the existing scene, which might appear to be a dissolve type of transition on a larger scale.



Transitions such as VisualStudio's flying box are extremely eye-catching when placed appropriately between clips, but overuse of such effects can make your video look amateurish.

Where Are They? Video-editing software typically includes a decent variety of transitions, so chances are good that you already have transitions at your disposal. For example, Adobe Premiere includes dozens of dissolve, iris, peel, slide, stretch, wipe, and zoom transitions, as well as several 3D effects. Ulead VideoStudio features 3D, build, clock, peel, push, roll, slide, stretch, wipe, and other transitions. Other video-editing applications, such as Discreet's edit, Pinnacle Systems' Studio DV, Pure Motion's EditStudio, and Sony's ES-3, also provide an assortment of transitions to choose from.

Within most video-editing applications, you'll see a small animation that shows each transition in action. Still, if you're not sure what effect a particular transition will really have even after viewing the demonstration, it's a good idea to see how the transition looks using your actual video content. Certain innocent-looking transitions can appear gaudy and distracting when used within a real-life video context.

When you veer from the transitions included with software and look toward plug-ins for assistance, you'll begin to find more exotic transitions. Using Adobe Premiere as an example, let's look at a few of the available commercial plug-ins that can boost the quality of your transitions. (Note that many plug-ins are available for more than one software product.)

Crystal 3D VORTEX from Crystal-Graphics. Professional animators created the 3D transition effects in Crystal 3D VORTEX (Volume 1 and 2, $79 each; http://www.crystalgraphics.com/videos). Volume 1 of this set will get you started with its 20-plus transitions, including shatter, logo flip, spiral, and morphing sphere. Volume 2 features transitions such as tumbling bricks, cascading and rotating louvers, flying film, turning billboard, zip it up, coin flip, basket shot, and more.

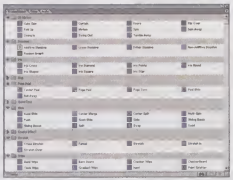
Hollywood FX from Pinnacle Systems. This plug-in family of products enhances transitions with transparency, shadows, shine, trails, motion blur, anti-aliasing, and more. Effects include money, peels, ripples, breaking glass, and many others. Which Hollywood FX product you decide to use probably depends on your wallet. The Bronze version is $299.95, Silver is $699.95, and Gold is $1,499.95 (http://www.pinnaclesys.com).

Lord of the Wipe from AccessFX. This gradient-based transition plug-in features image interpolation (point, linear, bilinear, and bicubic), rotation, scaling, edge softness, screen placement, and rotation placement—all for $49.95 (Video version, http://www.accessfx.com/lord.htm). AccessFX also offers TransLux ($49.95, http://www.accessfx.com/translux.htm), a pixel-based plug-in that lets you change the height and width, the density or transparency, and the movement of pixels in transitions.

SpiceMaster from Pixelan Software. With SpiceMaster ($299, http://www.pixelan.com), you can create subtle directional dissolves, organic transitions, and more. This plug-in is extremely flexible, letting you

keyframe the effect's position, orientation, softness, range, movement, border, glow, shadow, speed, and dynamic edge qualities.

Put Transitions To Work. When you have access to all sorts of fancy transition effects, it's tempting to jazz up your video production with as much techno fanfare as possible. And although this might help you become an expert at applying transitions, that does not necessarily make you a master of transitions themselves. Too many effects in a video, including transitions, can easily make a production look and feel amateurish. This experience is akin to Web sites that are jammed with blinking lights, time- and resource-consuming page transitions, and silly fonts that hurt your eyes. Desktop publishing programs also include a wealth of glitzy fonts, colors, and effects, but when you overuse them, you can ruin documents rather easily, and the intended message gets lost in the eye candy.



Although it depends on the video-editing software you use, you probably already have a host of transitions at your disposal. Adobe's Premiere includes dozens of creative transitions.

Transitions serve a purpose that's blatantly inherent in their name: They transfer the viewer from one scene to the next. Applied properly, transitions also help to set and preserve the mood of your production, and they grow increasingly important when you're switching to scenes that differ greatly. Transitions are part of your visual package that includes your actual video content, so it's vital you treat them with as much care that you treat your video clips.

One of the most widely used transitions, and one that is fundamental to filmmaking, is the aforementioned cut. This transition immediately drops the viewer from one scene into the next without interruption. Cuts are used so widely in today's filmmaking today that they're hardly noticed. They're also extremely effective when used properly. For example, imagine an entire episode of "Seinfeld" shot with one scene that encompassed all characters and no cuts. Not too exciting, right? Filmmakers use cuts to focus on characters and nonliving elements, as well as to create a mood.

But like the overuse of other transitions, the overuse of cuts can be intrusive. In fact, some modern filmmakers have moved effectively to the other extreme. Older "NYPD Blue" episodes, for example, forwent frequent cuts in favor of random pans, creating a sense of immediacy necessary for the show's content.

Nevertheless, if you're new to video and/or transitions, make cuts a priority in your productions if only to obtain a solid grasp on them. A good starting point is to shoot two or more people talking, and use cuts to change the focus from person to person.

Just as cuts are useful when moving between characters or objects in the same scene, dissolves and fades are effective when moving from one location or time period to another. For example, a quick dissolve could transfer a scene with two characters talking to a scene depicting the location they're discussing, and that same dissolve could be used again to transfer back to the characters.

Likewise, dissolves could split scenes that depict a landscape over the course of four seasons, as cuts might be too abrupt and wouldn't properly signify a change in time or place.

You can use fades in a more extreme fashion to represent a clear start, break, or end of a scene. For instance, you can begin with a black screen and fade into a landscape, or you can fade to black to end the scene or to complete the production. Again, cutting the scene abruptly might interrupt the flow of your video, so think about the mood at the beginning or end of a scene and how to best lead into or out of it.

Cuts and dissolves are common, often necessary, transitions. Although more exotic transitions aren't quite as necessary in the average video production, they can still be very useful when used correctly. For example, using a barn door transition to introduce a scene could be effective, depending on the scene content and layout. Similarly, using a burning transition to switch scenes could work well if you're aiming for a comedic effect, but it may not work as well if you're shooting a documentary about arson. Again, transitions should blend with the look and mood of your video and serve to move viewers along, pull them in more deeply, or introduce or end the production gracefully (or at least in line with the mood you've been portraying).

Heavy use of transitions, particularly those other than cuts, dissolves, and fades, is typically not a great idea, unless you're aiming for extreme novelty. We've seen professional videographers turn recordings of elegant weddings into outlandish circuses, thanks to overuse of flying hearts, peels, bar slides, and more. Even amateur home videos can lose substantial meaning when they're injected with loads of glitz. With this in mind, consider the message, mood, or story you're depicting, and select transitions that carry this theme effectively. In most cases, you'll find that a more relaxed approach will go a long way toward creating a tasteful production.

If you're looking to boost the size and quality of your transition collection, third-party plug-ins, such as Pinnacle Systems' Hollywood FX, include a swarm of high-tech effects.

It's Your Turn To Make The Transition. When you begin implementing transitions in your work, you'll enter a fantastic new world of possibilities. Depending on how you use them, transitions can turn a drab project into a winner or a worthy project into a loser. However, use some common sense before you apply transitions, as they can be as powerful as your content. You'll soon learn that without transitions, a video can suffer, and with ineffective transitions, a video can also suffer. In addition, start watching movies and television programs more closely, and you'll be amazed at how little you previously noticed transitions.

Now that you have the fundamentals under your belt, gather those video clips and see what you can do. LS

by Christian Perry

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File Fundamentals

What You Need To Know About Video File Formats

Everybody enjoys a good movie. The action, the scenery, the sound . . . it all adds up to the complete story-telling experience. Can you enjoy some of these characteristics while watching a movie on your computer screen? Sure you can. Media player software has been around for quite some time now. With the development of faster computers and all those multimedia-enhanced instructions, you can now enjoy high-quality video directly from your computer screen.

When you watch a movie or another video clip, you are actually watching a file made up of thousands and thousands of still images. When played rapidly, you get the illusion of fluid motion, similar to the concept behind flip-book animation.

How these images become inserted into the video file depends on a couple of things, such as the codec (compressor/decompressor) and the video file type. The file type and codec play a part in how the video and audio are structured in the file, how big (or small) the file is, and most importantly, what video player will correctly play the movie back on your computer. (For more information, see "It's A Codec Moment" on page 55.)

Before we go any further, we need to explain an important concept that plays a major role with video file formats. It is the color space used to determine the number of colors in each frame. A color space is nothing more than a way to describe, create, and visualize color. The human eye sees color in terms of brightness, hue, and colorfulness. The computer defines a color in terms of the brightness of red, green, and blue phosphor dots on the front of your monitor. Most graphics, regardless of whether they are static images or full-motion video, will be in the RGB (red-green-blue) color space.

This concept leads to the idea of how the computer represents each dot of color on-screen. Depending on the quality of your graphics card, you will be able to view graphics in one of a handful of color representations, such as 8-bit, 16-bit, and 24-bit color. The 8-bit color option lets you have a maximum of 256 unique colors on-screen at the same time, out of a color space palette of millions of colors. The same is true for the other bit modes: 16-bit color gives you as many as 32,768 simultaneous colors and 24-bit provides as many as 16,777,216 colors.

The numbers of colors and bit rates have an effect on video file sizes and formats. The rule of thumb is the higher the bit rate (such as 24-bit color), the more colors in an image (resulting in better quality), and the bigger the file (more video data to maintain and store). Let's look at some of the most popular video file formats in use today.

■ **Moving Picture Experts Group.** MPEG (Moving Picture Experts Group) is a popular compression standard for creating downloadable or streaming audio and video, and its files end in the .MPG file extension. There are three versions of the MPEG compression scheme: MPEG-1, MPEG-2, and MPEG-4.

MPEG-1 is a standard for medium-quality video and audio compression, providing compression ratios in the area of 50:1 to 100:1. The data stream of a MPEG-1 compressed file is approximately 150Kbps (kilobits per second) or about the same rate as a single-speed CD-ROM.

To achieve its compression, MPEG-1 takes a video key frame (complete representation of the image, with all bits included) at some predetermined interval and creates subsequent frames (up to the next key frame) that only contain data for the part of the image that has changed from the key frame. The next frame in the sequence might only have a small portion of the image change, such as an eyelid closing, so only that part of the image is inserted into the video track. Because of the slow bit rate and frame difference technique, MPEG-1's video quality is far below that of a standard television broadcast.

MPEG-2 builds on MPEG-1 by providing better compression codecs to provide higher quality audio and video. You can view a properly compressed video using MPEG-2 at near-laser disc clarity and CD-quality audio playback. This is why most modern digital systems, such as DVD and digital satellite systems, use MPEG-2 for their video format.

MPEG-4 is a loose combination of MPEG-2 and Apple's QuickTime format. MPEG-4 enables the production of more reusable

content and allows for better protection of content owner rights. MPEG-4 also is more flexible than existing technologies at delivering multimedia content such as digital television. At the other end, the client side, MPEG-4 allows for higher levels of user interaction with the content, as well as provides a means of supplying multimedia to mobile devices.

■ **Audio-Video Interleaved.** Developed by Microsoft as part of Video for Windows, AVI (Audio-Video Interleaved) is one of the most commonly used video formats. Based on RIFF (Resource Interchange File Format), AVI can have a mono or stereo audio track along with an 8-bit, 16-bit, or 24-bit video track. The Interleaved (or "I") aspect of AVI tells us the video and audio data are stored consecutively in the file. This means that a segment of video data is immediately followed by a segment of audio data.

There are several different ways (types of codecs) of encoding your video data into an AVI file. They are: Uncompressed, Video 1, RLE (Run Length Encoding), Cinepak, Indeo, M-JPEG (Moving-Joint Photographic Experts Group), MPEG-4, and IBM Ultimotion. Of these codecs, only Uncompressed, Cinepak, Indeo, M-JPEG, MPEG-4, and Ultimotion support 24-bit graphics. And as we mentioned previously, 24-bit graphics gives you the best possible picture quality.

■ **Windows Media Video.** As a subset of an established format, ASF (Advanced Streaming Format), WMV (Windows Media Video) is a file format that is gaining greater acceptance. Unlike AVI, you can stream WMV over the Internet or local network, making it an excellent choice for on-demand video broadcasting. WMV also supports most popular codecs, including MPEG-4.

Microsoft didn't intend WMV to be an editable format. It was meant to be the final file format once all editing was completed. WMV is actually a compressed file format that uses a **lossy compression** method to compress images to save space, which results in smaller file sizes. But using this compression method also results in the loss of some quality and duplicate data from the original file. This is the trade-off users make between reasonable file sizes and video quality.

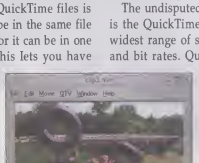
■ **QuickTime.** Originally created by Apple, QuickTime has grown from a Macintosh-only format to an ISO (International Organization for Standardization) standard. By far the most flexible of the file formats in terms of the number of codecs supported (18 at last count), QuickTime files can easily accommodate various kinds of data. The QuickTime format can be used to describe nearly any type of media structure. This makes it an ideal format for the exchange of digital media between platforms, and QuickTime players are available for Macintosh and Windows OSes (operating systems).

In a QuickTime file, the description of the media is stored separately from the media data. The media description, also known as the meta-data, is called a movie and includes movie descriptor information, such as the number of tracks, type of codec used, and playback timing information. The movie also has the index of where all of the media data is stored. The actual video frames and audio information is stored in the media data. A unique characteristic of QuickTime files is that the media data may be in the same file as the QuickTime movie, or it can be in one or more separate files. This lets you have a single movie file that actually plays back and displays video and audio information from other files.

■ **In-Depth Analysis.** If you get down to the nitty gritty, for all practical purposes, a video file is just a video file. It all really comes down to the type of codec you choose and the destination file format.

Files created in the MPEG file format only use MPEG codecs. These codecs only work with 24-bit per pixel color (8 bits for each red, green, and blue pixel), so you will get the highest possible number of colors in your finished product. And with the MPEG format, you can have screen resolutions up to 1,280 x 720 pixels and 60fps (frames per second) with full CD-quality audio.

AVI files give you a few more choices in terms of codecs, including 8- and 16-bit versions for specific situations. Like MPEG video formats, you will probably want to use one of the 24-bit codecs, such as Cinepak, Indeo, or M-JPEG, to create your AVI files.



With Apple's cross-platform QuickTime format, most users will be able to easily download and play your videos.

M-JPEG is the de facto encoding technique of choice for AVI files. But because M-JPEG is a collection of JPEG frames and each frame represents a complete image, this tends to make AVI files larger those with the same amount data in the MPEG format.

In addition, AVI files suffer from other major drawbacks: They can't be used if you want to stream your video, and they are limited to a 320 x 240 resolution and 30fps. These limitations make AVI unsuitable for full-screen, full-motion video. On the other hand, one of the biggest advantages to AVI is that almost any Windows computer system out there can play back a movie saved with the AVI format. Because the AVI player codecs are included in Video for Windows and Windows Media Player, which bundle with all recent versions of the Windows OS, any Windows system is capable of viewing the file, making it an almost ubiquitous video format.

The undisputed king of codecs, however, is the QuickTime format. It by far has the widest range of support for various codecs and bit rates. QuickTime can now also be streamed over the Internet. Another interesting fact about QuickTime is that it not only can play back video files, but it also can play back some Microsoft AVI files.

■ **Which One?** Deciding on which video file format to use is really a matter of opinion, but there are a couple of guidelines to keep in mind. Choose a file format and codec that uses 24-bit images because this will give you the best looking video possible.

Also, consider your video transport method: How are you and other users going to play the video? For streaming video via the Web, MPEG and QuickTime are the better format choices. For playing local or CD-ROM-based video, the AVI format will work just fine. Ultimately, your decision will depend on the hardware and software tools at your disposal, as well as your audience. LS

by Keith Schultz

Web-Ready Video

Considerations Involved In Preparing Streaming Video For Internet Use

Years ago, the typical audience for our video endeavors included a few friends and family huddled in a dimly lit room. Today, thanks to the Web, we can now expand that audience to hundreds or thousands of viewers who can access your video over the Internet.

While the Web wonderfully expands our potential audience, it also constricts our options when dealing with video content. Sure, that 40MB video clip configured with the high-quality settings looks fantastic on your computer, but anyone accessing it from the Web will be lucky to see it at all. Although computer performance and Internet connection speeds continue to ramp upward, Internet video must be relatively small in size to accommodate a potentially vast audience with varying systems and connections.

Nonetheless, creating video for the Web is a fascinating experience that can change the way you approach your work. This article will explain the technologies behind Web video, including formats and techniques. Much of the content is described as "streaming," which means the video transmits to a viewer's computer in a stream, instead of transferring as a single file and making the recipient wait to watch it later.

It's important to remember that although you'll be dealing with streaming technology, your viewers might also be able to simply save the file to their computers to watch at their leisure. This choice will depend on the format you choose. For example, users can't download Windows Media Video (uses the .WMV file extension) as a file; they can only view it as a stream. You can configure other formats, such as RealMedia (with its .RM file extension) and QuickTime (with the .MOV file extension), for streaming or downloading, or both.

Streaming methods. Two methods of streaming video are generally used today: HTTP (Hypertext Transfer Protocol) and RTSP (Real-Time Streaming Protocol). You're probably familiar with HTTP because it's the primary protocol used to deliver content on the World Wide Web. Just as it's friendly with Web content, HTTP is also friendly with streaming content. HTTP streaming content first downloads to your computer and then plays only after a certain amount caches onto your computer's hard drive. HTTP content can usually pass through most corporate firewalls, which may or may not be a concern for you, depending on your intended audience. HTTP streaming allows for files with a higher data rate, and therefore, is a better choice for files of a higher quality. However, the higher the quality, the longer the file will take to download, and higher-quality files also place more demands on the viewer's computer. And video streamed via HTTP can be a problem if the viewer doesn't have enough hard drive space to store the file.

RTSP files, on the other hand, execute on the server and play back on the viewer's computer, which allows for more flexibility. With RTSP, hard drive space on the viewer's end isn't a concern, and he can access different portions of the clip at any time (a benefit that HTTP streams don't provide). Because RTSP files are delivered in real-time and not downloaded, they're also useful if your viewers are likely to watch your video on PDAs or similar devices. But unlike files using HTTP streaming, RTSP files often have a difficult time passing through corporate firewalls.

The type of streaming method you use depends on what you're doing with your content. If you plan to stream live events (particularly *long* events), RTSP is usually the better choice. But if you're offering video that was already filmed, or if you intend for viewers to download your content and watch it later, HTTP is a better fit. HTTP is also a good fit if your video files are small.

Your choice of streaming method also depends on where your video resides. If you're running your own Web server, you'll be able to provide HTTP streaming with no problem, and depending on your OS (operating system) and system configuration, you also should be able to provide RTSP streaming without much more trouble. However, if your video resides on your Web site, provided by your ISP (Internet service provider) or another hosting service, you'll be at the mercy of its rules and requirements in terms of the technology you can use.

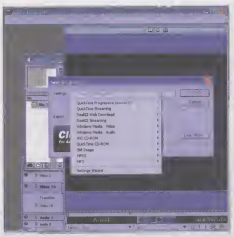
■ **Streaming Formats.** Most Web-based video files use one of three formats: QuickTime, RealMedia, or Windows Media Video. Like streaming methods, your choice of format often depends on your video content itself, as well as your audience. Let's take a closer look at these formats to see which might be best for your projects.

QuickTime. Apple's QuickTime has long been a staple of the streaming world, and for

good reason. The QuickTime format, and the .MOV file extension it usually sports, is reliable and speedy, plus it's compatible with a wide range of systems. The free QuickTime Player (http://www.apple.com/quicktime) is needed to play the files, and although Apple claims Windows and Mac customers have downloaded QuickTime 5 more than 100 million times, the technology will not necessarily be installed on the computers of all the viewers of your video. However, the player is simple to download and generally good to have on hand for viewing other QuickTime content, so requiring a relatively painless download isn't a bad thing.

QuickTime streaming uses RTP (Real-Time Transport Protocol), which is similar to RTSP in that it doesn't download the entire clip to the viewer's computer, but instead delivers a constant stream.

Although the QuickTime Streaming Server software is designed for the Mac OS X Server, it's also available for Windows NT and Windows 2000 as an open source package called Darwin Streaming Server. This server provides support for MPEG-4 (Moving Picture Experts Group-4) streaming and MOV files. You'll need QuickTime Pro ($29.99) to create QuickTime video files.



Programs such as Adobe Premiere let you export your video into a Web-ready video format such as QuickTime, RealMedia, or Windows Media Video.

RealMedia. RealNetworks' RealMedia format has also been a popular streaming choice for many years. The RealOne Player (free; http://www.real.com, click the Free RealOne Player link), used to play RealMedia video files (usually those with the .RM file extension), delivers a high-quality picture, even if the video contains a significant amount of movement and detail. Like QuickTime, RealMedia needs its own player to play back the video, so if your viewers don't have RealOne Player installed, they'll need to download and install it.

The RealOne Player does have a large installed base, but many users consider the software intrusive. Nonetheless, thousands of Web sites use the RealMedia format because the files are small and deliver the aforementioned high level of quality. You can use the free RealSystem Producer Basic to create RealMedia video files. Some digital editing programs, such as Adobe Premiere, can also export video files into RealMedia format.

Windows Media Video. Windows Media Video, Microsoft's most recent video format, performs well across a wide range of systems and Internet connection speeds. Viewers will need the Windows Media Player (free with recent versions of Windows) to watch the Windows Media Video files (ending in the .WMV file extension). Of course, this technology is designed for Windows-based PCs, but Mac users may be able to view WMV content, as well (although the reliability and picture quality may be decreased).

You'll need the free Windows Media Encoder (http://www.microsoft.com/windows/windowsmedia/wm7/encoder.asp) to

No Web Site? No Problem

Now that you shot the perfect video, formatted it, and prepared it for its Web debut, you have one problem: You don't have a Web site. Fortunately, there are other outlets for distributing your video.

The first area you'll want to investigate is your ISP (Internet service provider). Many ISPs include 5MB (or even 10MB) of server space with Internet accounts for you to create your own Web page. See if your ISP lets you place streaming content (or any multimedia content) on this space. Unfortunately, many ISPs won't allow streaming content. For example, GeoCities used to let users stream RealMedia files, but recently discontinued this practice.

Another, more promising outlet is a multimedia-focused site that lets users post streaming content at no charge. Several sites provide this service, and each varies according to the amount of space offered and extra features provided. Of course, you're also limited to what you can post because you must abide by the rules and regulations of the host. Nevertheless, these services are a quick, easy way to get your video online.

Sony's ImageStation (http://www.imagestation.com) lets you store as much as 15 minutes of video for free. Once you post your video, you can simply enter the email addresses of people you'd like to see the video, and ImageStation will notify them for you. RadicalZoo (http://www.radicalzoo.com) lets you post clips "of any reasonable length," although they recommend less than 15 minutes per clip. You can designate your video content as public or private, and if you go the private route, your content will be password-protected. Guy Graphics (http://www.guygraphics.com) also lets you upload videos of as much as 20MB at no charge.

If you do use a free video hosting service, make sure you read the fine print carefully. If you don't, you may unwittingly relinquish all rights you have (or *had*) to your video masterpiece after you post it to the service. Some of the user agreements are long, but it's worth your time to read them, especially considering the amount of time you spent shooting and preparing your video.

You also can email video files to your audience, although this method requires that you know precisely who your audience is. Unless you're willing to spam your video to hundreds or thousands of unassuming recipients (a practice we don't recommend), you might have difficulty garnering word-of-mouth publicity for your work. Besides, with email, file size limits your video options because many ISPs won't accept attachments larger than 1MB. Even so, email can still be a convenient outlet for distributing your video in some select cases.

If you do choose email, look into efficient compression tools that can shrink your video files as much as possible. You also can consider breaking your files into multiple parts to accommodate the limited bandwidth of email servers. For more information about emailing video, see "You've Got Video" beginning on page 125. □

create WMV files, although programs such as Adobe Premiere can also create WMV files.

Choose A Codec. The video format is not the only choice you'll need to make to create a successful streaming video, you also might need to choose a codec. A **co**der-**dec**ompressor) reduces the size of your video file and helps play it back once it's accessed via a stream or a file. Some programs, such as Adobe Premiere, include Web output features that will help apply the proper codecs necessary for Web delivery. Otherwise, you'll need to explore different compression tools and codecs, and it's wise to conduct some experimentation to find out what codec best fits your requirements.

The Radius Cinepak codec, for instance, can produce high-quality video files, but to make file size compatible for Web viewing or downloading, the quality needs to be reduced substantially. In this case, the Sorenson codec could be a better choice, although it may not be available with the software you're using. In the end, you'll need to find a codec that fits your size requirements and changes your video as little as possible quality-wise. For more detailed information about codecs, see "It's A Codec Moment" beginning on page 55.

Shoot The Video. When creating or preparing video intended for streaming, it's vital to consider your audience before your camera is in hand. Assuming your Web site is not password-protected, anyone can access the video content on your site, and that audience could have a wide range of system and bandwidth capabilities. Some viewers might watch your video on 2.4GHz Pentium 4 computers via a DSL (Digital Subscriber Line) connection, while others might be stuck with a 300MHz Pentium II and a 28.8Kbps (kilobits per second) modem. With this in mind, you'll likely need to shoot and prepare your video to accommodate the widest possible range of systems and bandwidth.

Although it's possible to use video for the Web that wasn't originally intended for streaming, it's not necessarily ideal, as many filming techniques don't translate well to streaming content. Therefore, if at all possible, create video intended for the Web from scratch.

When shooting your video, try to minimize camera movement. If you own a tripod, use it; otherwise, find something else to help keep the camera from moving. Jerky camera movements are difficult to watch on Web video, often because the screen size is limited (again, depending on the viewer's system and connection). Pans and zooms can also translate poorly, as a slow connection or system could slow a streaming video to a near halt if it has to keep up with the moving camera. Also, aim for a simple background that displays your forefront subjects clearly, and avoid bright backgrounds that could create a muddy picture. Similarly, try to implement sufficient lighting. A well-lit Web video is much easier on the eyes—and easier to discern—than a poorly lit video. Because video quality can degrade through the editing and compression process, it's important to produce original content that's as high quality as possible.

When shooting your subject, get in as close as possible. Remember that computer monitors are typically much smaller than television screens, and they are tiny compared to movie screens. In fact, most streaming media displays in a smaller window on the monitor, so if the subject in your video is far away, there's little chance viewers will see what's going on. Although you might be used to shooting from all angles and distances, you'll need to change your habits if you want effective online video.

Using bright backgrounds, such as in the example shown here, can cloud a Web-based video, but its close focus on the subject is an effective technique.

Obtaining high-quality audio is also of concern when creating your streaming content. Just like your video content, your audio needs to be in a small package, and if you rely on your camera's built-in microphone or a shabby external microphone, your compression process could have a difficult time packaging all the useless sounds that your audio track contains. With this in mind, use a high-quality external microphone that can capture clean audio.

Video Preparation. Just as methods for shooting your video are key to your streaming success, so are methods for editing and preparing the video. To start, make sure you capture the video at the highest quality you can. You can always adjust your quality settings later if the file is too large, but if you start by capturing your video at a low quality, you can't turn back.

Once you're ready to mold the video to your specifications, watch it to see what you can crop. A lot of useless motion or detailed backgrounds will only hinder your streaming effectiveness, so it's a good idea to cut it when you see it. Similarly, image glitches can often appear around the edges of video screens, so if you see glitches appearing in your material, crop them out.

Transitions can be handy when editing digital video, but they're not particularly effective in streaming content. Too many effects can muddy an otherwise smooth production, and when you're trying to watch a streaming video in a small window (or in a larger window with lower image quality), glitzy transitions can be distracting and an eyesore. For more information about transitions, see "Trouble-Free Transitions" on page 80.

If you do need to use text for titles or other announcements, use plain, large type that viewers can read easily on a small screen. Most viewers will prefer to read your plain message rather than miss it altogether because the exotic typeface was difficult to read.

When considering your audience, consider their ears along with their eyes. You may be tempted to create a spectacular soundtrack with plenty of effects, but such efforts will be lost on a majority of listeners whose computer sound system features the pitiful plastic speakers that were bundled with their computers. Just because your video looks and sounds great on your wonderful digital-editing system doesn't mean it will look and sound great to your audience.

Enter A Brave New World. As our lives continue to grow more Web-centric, you might find that your time spent with Web video work soon outpaces typical video work. The world of Web video can be complex, but considering the possibilities it presents, you'll find that the extra effort can be very rewarding. As discussed, your initial forays into this space will entail a healthy dose of experimentation. Be prepared to toss aside previously successful methods of shooting and editing video in favor of new approaches. And although this process can seem limiting and even frustrating, remember that your audience will certainly appreciate your efforts when your video successfully streams or downloads. LS

by Chrisfian Perry

Lights, Camera, Action . . . Uh-oh

Troubleshooting Video Capture & Editing Problems

To produce a quality home movie, you need the vision of an artist, the ambition of an entrepreneur, the patience of an octogenarian, and the ingenuity of a handyman. The vision inspires you to start the project, ambition prods you to complete it, patience helps you do it well, and ingenuity helps you deal with the numerous problems that arise throughout.

Indeed, you most likely will encounter a host of technical hiccups and headaches while capturing and editing digital video. Careful preparation can prevent many of these problems from happening in the first place, but pre-emptive measures offer little assistance when your system actually takes a turn for the worse. At that point, the best way to deal with the situation is to address it promptly.

■ **Capture Quandaries.** The transfer of video footage to your PC from a VCR or camcorder can lead to all sorts of trouble. Unfortunately, you cannot continue with the editing process until the footage is contained within your computer system. We'll help you handle the problems that are most likely to strike during a video capture.

Problem: The computer will not recognize my VCR or camcorder.

Probable Cause: The hardware is not set up properly.

Solution: Assuming that you are using the right cables and the cables are functioning properly, the first thing you should do is verify that the video capture card has been installed correctly. Review the installation manual and check that the card is seated securely in the expansion slot. You also should review the card's capabilities and features. Some video capture cards are designed specifically for digital or analog input and will not support a capture from anything else. Your card must support input from your video source.

Next, you need to manually check the connections between the video source and the PC. The jacks should fit snugly and securely into the appropriate ports: namely, the output port(s) on the video source and the input port(s) on the capture card. The video source must be plugged in and turned on, as well. Some users make the mistake of assuming that a USB (Universal Serial Bus) or IEEE 1394 (often referred to as FireWire) port can provide enough power to fuel a DV (digital video) camcorder. It can't. You should use an electrical adapter to plug your camcorder into a grounded AC power source before attempting to download data to your PC.

Finally, you should update the **device drivers** (software that helps a hardware device communicate with the rest of the computer) for all of your digital video devices, including DV camcorders and video capture cards. Driver updates are especially important if you have recently added new hardware and software to your computer system. You can get updated device drivers by visiting the Support or Download area of the device manufacturer's Web site. We recommend the periodic updating of device drivers for all of your hardware components.

Problem: The computer still won't recognize my VCR or camcorder.

Probable Cause: Your video-editing software does not support video capture or isn't configured correctly.

Solution: Review the software users manual to determine whether your video-editing application supports input from an external source. Some won't. If yours does not, you will have to use the software that came with your video capture card or purchase a new video-editing application. Roxio VideoWave ($99.95, http://www.roxio.com), Ulead VideoStudio ($99.95, http://www.ulead.com), and Pinnacle Studio ($99.99, http://www.pinnaclesys.com) are three consumer-oriented video-editing applications that support input from analog and digital video sources.

Once you've determined that your software has video-capture capabilities, make sure it is set to receive input from the appropriate video source. Your software will not let you capture footage from a VCR, for instance, if it is looking for input from a cable TV port. Read the users manual to learn how to configure the software for a video capture.

If all else fails and you suspect the software may be a problem, try reinstalling it.

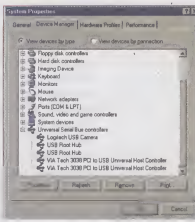
Problem: My computer won't let me capture more than 2GB of video footage at a time.

Probable Cause: Your computer is running Windows 95 or a 16-bit version of

Windows 98, neither of which supports files that are more than 2GB in size.

Solution: You either need to capture smaller video files or upgrade your OS (operating system). You can purchase an upgrade version of Windows XP Home for $99. Upgrades are limited only to users of Win98, Windows Me, Windows NT 4.0, and Windows 2000. If your PC is still running Win95, you'll have to purchase the full WinXP Home upgrade for $199.

Note that you may need to upgrade your system hardware to support the new OS. For best performance, WinXP requires a system equipped with a 300MHz or faster processor, 128MB of RAM, and at least 1.5GB of hard drive space. Visit Microsoft online (http://www.microsoft.com) to obtain a full list of system requirements for WinXP.



The USB (Universal Serial Bus) ports on your PC must be active in order for them to recognize your USB DV camcorder. You'll know if the ports are active if the Device Manager lists multiple USB controllers, and they don't have exclamation points next to them.

Problem: The hardware is set up properly and the software is configured correctly, but my computer refuses to recognize my DV camcorder.

Probable Cause: The USB port is not active.

Solution: One of the more common reasons for a failed connection between a DV camcorder and a computer is that the USB port is not active. To activate the USB port so that it can receive data, you must install the USB software that came with your PC. Consult the computer manufacturer for details about locating or obtaining this software.

If you're uncertain whether your PC's USB port is active, access the Device Manager and look for a Universal Serial Bus Controllers listing. To access Device Manager in Win9x and WinMe, you need to right-click My Computer, select Properties from the pop-up menu, and click the Device Manager tab. You can access it in WinXP by opening the Start menu, right-clicking My Computer, selecting Properties from the pop-up menu, clicking the Hardware tab, and clicking the Device Manager button.

The Device Manager will list all of your system hardware. You'll know whether the USB port is active if the following three conditions are true: the Device Manager includes a listing for Universal Serial Bus Controllers; the listing contains sublistings for your particular USB port; and neither the listing nor its sublistings have yellow exclamation points next to them. An active USB port will satisfy all three conditions.

Problem: The captured video footage looks grainy and some colors seem distorted when I play the video on my computer system.

Probable Cause: Your system's display properties are configured to use only 256 colors.

Solution: It may sound like a lot, but 256 colors are not enough to adequately portray the many shades, hues, and tints that make an appearance in your video footage. To see your captured video in all its glory, you need to change the display properties to use the 16-bit or 32-bit color setting.

You can access the display properties by right-clicking any empty space on the Windows Desktop and selecting Properties from the pop-up menu. In the resulting Display Properties dialog box, choose the Settings tab. The next step varies depending on which OS you use. If you use Win9x or WinMe, you should locate the Colors field and select either the High Color (16-bit) or True Color (32-bit) setting. If you use WinXP, you need to locate the Color Quality field and select the Medium (16-bit) or Highest (32-bit) setting. Either way, click OK to accept the changes. When you are prompted to restart the computer, do so. The next time you play back the captured video, the colors should look crisp and clear.

For the best performance, you should configure your PC's display settings to High Color (16 bit) or True Color (32 bit).

Problem: The captured video looks choppy when I play it back on my computer.

Probable Cause: The capture was disrupted, resulting in the loss of some frames.

Solution: A typical digital video file is made up of between 15 and 30 frames (individual images) per second of footage. A video file that is one minute in length could include as many as 1,800 individual frames, for instance, while a file that is 10 minutes in length could consist of as many as 18,000 frames.

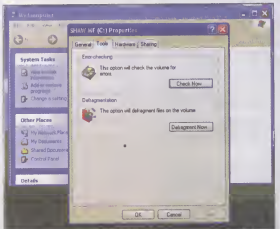
Given the vast number of images involved, you might assume that the recording software could drop (lose) a few frames without having a negative effect on the quality of the resulting video file. Such an assumption would be wrong. The absence of a single frame within an entire video file causes a temporary blank spot that makes the video appear to jump. When a file includes many dropped frames, the resulting video looks choppy. The only way to rectify the problem is to delete the captured video file and rerecord it. But first, you must identify and eliminate the disruption that caused the dropped frames.

The most common source of dropped frames is an overburdened system. The system processor, memory, and hard drive must be allowed to devote adequate resources to the capture process. Fortunately, you can unburden your system by taking a few simple steps before you initiate the capture.

First of all, you should run the ScanDisk and Disk Defragmenter utilities to ensure that the Windows drive (the hard drive on which Windows is installed) is clear of disk errors and clutter that may hamper the capture. To run these programs in Win9x or WinMe, open the Start menu and burrow through the Programs, Accessories, and System Tools folders until you see the ScanDisk and Disk Defragmenter options. Click each and follow the on-screen prompts to run the utilities. You can run these programs in WinXP by selecting My Computer on the Start menu and, in the resulting dialog box, right-clicking the Windows drive and

choosing Properties from the pop-up menu. Click the Tools tab in the resulting dialog box, and then click the Check Now and Defragment Now buttons to run each of the utilities.

You also should make sure the Windows drive has at least 10% of its total capacity reserved as free space. Even if you save the footage to another hard drive dedicated solely to the storage of digital video files, the drive on which the capture software is installed must have enough breathing room to function properly. Open My Computer, right-click the Windows drive, and select Properties from the pop-up menu. On the General tab, take note of the amount of available free space. If the drive is running short, you can pick up the much-needed space by deleting unnecessary files, such as TMP files and files from the Recycle Bin. You can gain even more room by moving outdated data files to another storage media.



Run ScanDisk and Disk Defragmenter to minimize the likelihood of dropped frames during a video capture. You can access both utilities in Windows XP by opening the Drive Properties dialog box.

A third step is to shut down any application that is not directly related to the video capture. Close all of your open programs and utilities, including any minimized applications that show up on the Taskbar at the bottom of the screen. Next, press the CTRL-ALT-DELETE key combination to access the Close Program dialog box (in Win9x and WinMe) or Windows Task Manager (in WinXP), both of which let you shut down programs that are running in the background. Antivirus, multimedia, and communications applications are particularly likely to lurk in the background and consume system resources.

To close these programs, highlight each one in the dialog box and click the End Task button. If a verification message appears on-screen, click its End Task button, too. Repeat the process until you've cleared the dialog box of most programs. You should not close Explorer and Systray, nor should you close the video capture application.

Finally, review the users manual that came with your video capture software to determine how to turn off the playback preview feature. This feature lets you watch your video while you record it from a VCR or camcorder to your PC. This is a popular option, but it requires your system to expend memory and processing resources that could be better spent assisting with the capture.

Problem: I can't hear any sound when I play the captured video.

Probable Cause: There is a problem with the audio equipment.

Solution: Most of the audio problems that occur during a video capture are easily remedied because they track back to a simple equipment problem. Check that the speakers are plugged in and turned on. The volume should be turned up to an audible level. If you captured the video from a VCR, which typically has separate audio and video cables, make sure the audio cable was connected to the proper audio input port on the video capture card.

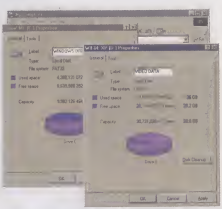
Speaking of the capture card, it must be set up properly so it can share audio data with the sound card. In many cases, this entails an internal or external cable that physically connects the sound card and the video capture card. Review the users manual to determine whether you installed the capture card correctly.

Problem: I don't like the quality of the captured video. The footage looks choppy, the audio is garbled or out of sync with the video, or my system locks up and crashes when I attempt to play it back.

Probable Cause: Your PC cannot support the capture settings.

Solution: When capturing video, you must leverage the desire for quality with a realistic understanding of your system's technical capabilities. Choppy footage, out-of-sync audio, and frequent crashing indicate that your quest for quality conflicts with the PC's technical limits. The first thing you should do is review the recording settings and adjust them if they're too high. We suggest a frame rate of 29.97fps (frames per second) and a frame size of 640 x 480 for video that you plan to display on a PC. Choose a frame size of 176 x 144 and a frame rate of 15fps for video that you plan to display on the Web.

Next, you need to make sure your PC has what it takes to support a video capture. At the very least, it needs a 300MHz or faster Pentium-class processor and 128MB or more RAM. You'll get best performance if the computer runs an OS like WinMe or WinXP Home that is optimized for digital video. You should have a hard drive that boasts a spin speed of 7,200rpm (revolutions per minute) and a sustained data transfer rate of 6MBps (megabytes per second). You also need a video card that supports the capture of video at a minimum frame size of 640 x 480 and a frame rate of 29.97fps.



To ensure the quality of your video captures, the Windows drive (typically the C: drive) should have at least 10% of its total capacity reserved as free space. You can further ensure the quality of your video captures by saving the captured video to a second hard drive (the D: drive in this example).

Problem: My captured video looks pixelated, fuzzy, faded, or choppy.

Probable Cause: The capture settings are set too low.

Solution: In an effort to minimize the amount of stress on a system, some users configure their capture software to the lowest settings. These users may select a frame size of 120 x 96, for instance, and a frame rate of 15fps. Such capture settings certainly won't tax your system, but they will result in recordings that look grainy, fuzzy, faded, and choppy.

Unless you plan to post the captured footage on the Web or send it as an email

attachment, in which case you should sacrifice quality so that your audience can access the video quickly and with minimal inconvenience, we suggest that you boost the capture settings to a frame size of 640 x 480 and a frame rate of 29.97fps. Refer to the users manual for specifics on changing these settings with your capture software. If your capture software does not give you the option of increasing the frame size and frame rate—many low-end and early-model video capture cards do not—you may need to upgrade your video capture card. Among manufacturers that offer video capture cards, ATI Technologies (http://www.ati.com) and Pinnacle Systems (http://www.pinnaclesys.com) are two of the best.

Note that you also may experience this problem if your PC's Display settings are configured for 256 or fewer colors. To verify these settings, right-click the Desktop and select Properties from the pop-up menu. In the resulting Display Properties dialog box, click the Settings tab and locate the Colors field (in Win9x and WinMe) or Color Quality field (in WinXP). Make sure it is set to the 16-bit or 32-bit option.

Problem: The original footage is in full color but the captured video appears in black and white.

Probable Cause: You have a problem with your video cable(s).

Solution: Old and damaged cables can prevent your capture card from picking up all of the video footage as it travels from the video source to the PC. Consequently, the first thing you should do is check the cable(s) that connect the video source to the capture card. Make sure the cable(s) is not frayed or otherwise damaged and that the jacks fit snugly in the ports at both ends. If the cable(s) is old, you may want to replace it with a newer one. Don't skimp when buying a replacement either. When it comes to video and audio cables, you get what you pay for.

Next, you should check the capture software to determine whether it is configured for the correct cable type. If you have an S-Video cable, for instance, the software must be configured to receive data through the S-Video ports. Review the users manual to learn how you can check this setting in your capture software.

Video footage that looks pixelated, fuzzy, faded, or choppy is often the result of incorrect capture settings. Ulead VideoStudio, like most other programs that support video capture, offers an assortment of frame size settings. We recommend a setting of 640 x 480 for high-quality videos.

■ **Editing Obstacles.** Getting the footage into your PC is one thing. Editing it into a quality home movie is another. Most of the problems that you encounter at this point are related to your particular editing application and therefore are best addressed by the software developer. Nevertheless, we can help you work around the few universal trouble spots that do exist.

Problem: My video-editing software runs s-l-o-w-l-y.

Probable Cause: You have other applications running on your PC.

Solution: Video-editing software demands the full attention of the available system resources. It cannot provide optimum performance if your computer is preoccupied with antivirus software, Web browsers, system maintenance utilities, and other programs running in the background.

Before you open the video-editing application, you should close all programs currently running on your PC. Use the CTRL-ALT-DELETE key combination to access the Close Program dialog box (in Win9x and WinMe) or Windows Task Manager (in WinXP) and put an end to applications and utilities that were loaded when you **booted** (turned on) your PC. You should see much improved performance when you launch your video-editing application.

Note that even under the best conditions, your video-editing software may seem a bit slow in responding to your commands. This is natural. If you feel that you must wait too long for the program to perform the simplest of functions, you should consider upgrading your PC.

Problem: My system locks up or crashes when I start editing my video.

Probable Cause: Your PC does not meet the recommended system requirements listed by your video-editing software.

Solution: Some manufacturers will list system recommendations, as well as system requirements. You should follow the system recommendations whenever they are given. The failure to do so will result in slow and unproductive editing at best or a system that locks up and crashes at worst.

If your system performs dismally—or doesn't perform at all—when you try to run the editing software, you should re-examine the system recommendations and make any upgrades that are necessary. Depending on how much editing you plan to do, you may find it beneficial to buy a new system that has been outfitted specifically for video-editing purposes. See "System Specifics" on page 52 for a full explanation of the equipment you need.

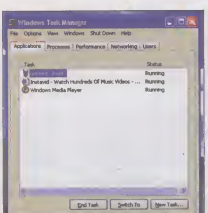
Problem: I cannot access a clip or effect contained within the editing application's content library.

Probable Cause: The clip or effect does not exist on your computer.

Solution: The clips and effects contained within the editing application's content library are really just shortcuts that point to the actual location of the clips and effects on the hard drive. If you delete or move these clips and effects from your system, the editing application cannot access them and associated shortcuts in the content library will

fail when you try to use them.

One solution is to return the clip or effect to its original location on your system or network. Another solution is to delete the dead shortcut and replace it with a new shortcut that points to the actual location of the clip or effect. Refer to the users manual to learn how to add content to your video-editing application's content library.



Use the Close Program dialog box (In Windows 9x and Windows Me) or Windows Task Manager (In Windows XP, shown here) to shut down all open applications before you start editing video.

Problem: I edited my movie at a frame size of 640 x 480, but it displays at 352 x 240 when I play it back.

Probable Cause: The video was captured at a frame size of 352 x 240.

Solution: The frame size of any given video file is determined at the point of its capture. You cannot increase the frame size simply by setting it higher during the editing process. To avoid complications, you should edit your video at the same frame size and frame rate that you captured it. Refer to the software manual to learn how to set the frame size for your video project.

Problem: When I attempt to save my edited movie, the computer locks up or the software prevents me from saving the file.

Probable Cause: Your movie file is too big.

Solution: Yes, digital video files can get big, and when they become too big, your system may have trouble handling them.

How big is too big? Well, a 2GB video file has a pretty good chance of crashing your system. Whether the crash is caused by the OS (Win9x and other OSes that use a FAT16 file system, a system for organizing data on the hard drive, restrict file size to less than 2GB) or the video format (the standard AVI [Audio-Video Interleaved] file format has trouble accommodating files larger than 2GB in size) isn't the point. If you want to create extra-large video files, you should do it on a PC governed by the NTFS file system and either create multiple AVI files or save the video in a format that supports large file sizes, such as the OpenDML AVI format or the proprietary format used by your video-editing software. Refer to the users manual that comes with your video-editing software to determine which file format will work best for your project.

Problem: My edited video is laden with video artifacts (image distortions).

Probable Cause: Something has gone wrong with the compression algorithm.

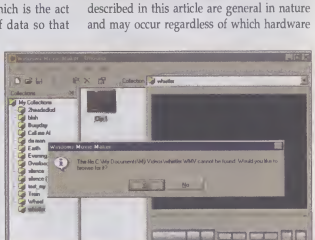
Solution: Compression, which is the act of condensing large bodies of data so that they fit into small spaces, is a necessary part of digital video editing. Fortunately, you don't have to think about it very much. Your video-editing software should handle most of the compression details for you.

Every once in a while, however, you may encounter some video artifacts—anything from horizontal lines to bursts of pixelation—that can be traced back to problems with the video file's compression settings. These problems typically arise either when the video file overwhelms the compression algorithm (set of instructions to perform a certain task) with a flood of data or when the program is set to a compression ratio that is too high to accommodate the video footage. Either of these situations are likely to occur when the footage portrays a lot of motion.

Why is extensive motion a problem? Compression algorithms tend to look for and eliminate redundancies among frames. This works because most footage consists of a smaller moving subject, such as a child, a bride, or an athlete, in front of a larger motionless background, such as a yard, a church, or a basketball court. Footage that changes frequently, however, puts the compression algorithm in the awkward situation of finding few or no redundancies. The algorithm cannot compress the data adequately, resulting in distortion.

The bad news is there's not much the average user can do to reduce the effects of artifacts in a compressed video. Users of high-end programs, such as Adobe Premiere ($549, http://www.adobe.com) and Avid Xpress DV ($1,699, http://www.avid.com), have the option of manually lowering the compression ratio, though this will greatly increase the file size (and the problems caused by that may be more significant than the problems caused by a few artifacts). The good news is that artifacts of this type are relatively rare.

■ **Help When You Need It.** The problems described in this article are general in nature and may occur regardless of which hardware and software you use. However, many of the problems associated with video capture and editing relate back to the use of a particular capture card or editing program. For help with problems not addressed or resolved here, refer to the users manual that came with your digital video software and hardware. LS



The video-editing application's content library includes shortcuts to multimedia files on your PC. Moving or deleting those files renders the shortcuts inactive. You may even receive an error message similar to this one.

by Jeff Dodd

Digital Darkroom

Create High-Impact Images

In the not-so-distant past, photography was often regarded as a pursuit that was best undertaken with a clear eye toward not just your lens but also the ongoing series of investments you were getting yourself into.

Your purchase of a camera, costing hundreds of dollars, was only the beginning. There was also the never-ending supply of film, and for every roll, you had to pay someone else to develop it and process the prints. That was fine at first, but eventually you would want more control over your work. So you built a darkroom: at least one enlarger, chemicals, trays, a timer, and lots of miscellaneous tools. Aside from blocking out all light, your darkroom needed running water and ventilation and time came for you to apply for a home remodeling loan....

Fortunately, this is no longer the only way to become an ace photographer. The across-the-board advances in digital technology have advanced the art and science of photography. Once a lo-fi gimmick, digital photography is now a viable alternative to the traditional camera-and-darkroom combination.

The Digital Difference. It didn't happen overnight, but the quality of digital photography now rivals that of old-fashioned film in nearly all respects. Although early digital-imaging equipment captured less visual information about its subject than standard 35mm film, this equipment has since come of age to the point that even some professional photographers no longer use film at all.

First the bad news: Try as you might, with digital you still probably won't obtain the richness and vibrant textures of an Ansel Adams print from decades ago, particularly in the large-scale formats in which he often worked. But then, how many of us use a master the likes of Ansel Adams as the yardstick for measuring ourselves?

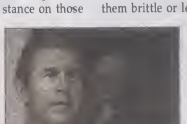
Now the good news: If technological history tells us anything, it says that that kind of quality will eventually be attainable. The 1-megapixel cameras that were considered top of the line a few years ago now occupy the bottom tier in terms of quality. Top professional gear now operates at a crystalline resolution of 5 megapixels, and only a fool would bet that the high end won't get even better.

Although there has always been a divide between professional and consumer-grade equipment, that gap seems to get narrower all the time, as rapid advances in technology push the high-end specs down within the reach of the rest of us. Nearly anyone can explore digital photography with dazzling results, and without breaking the bank. Cameras with resolutions of up to 4 megapixels have price tags comparable to their film-based counterparts.

If you also want to retain maximum control over your shots, image-editing software will run a fraction of the setup costs involved with a traditional darkroom. The benefits aren't just monetary, either. A good image-editing suite can bring to photography the same convenience and flexibility that word processors brought to typing.

So who is a candidate for a digital darkroom? Just about anyone, regardless of his level of experience. If you're already a veteran film photographer, equipping your PC with a quality scanner, printer, and a comprehensive editing suite can greatly expand the capabilities of your traditional darkroom. If you're a beginner, going digital can be a great way to sharpen your skills without burning through dozens of costly rolls of film and negative test sheets.

If you fall somewhere in between, you've probably worked through enough frustrating darkroom sessions to get excited by the possibilities that await. One thing is for certain: Thanks to digital editing, you no longer have to take a like-it-or-lump-it stance on those photos that come back from the drugstore.



Our president or some ancestral look-alike from a vintage Texas tinlype? After some sepia toning and image-aging treatments, you may have to look twice.

■ **Inside The Digital Darkroom.** Manipulating your photographs can be as easy or as advanced as you want to make it. As you master the basics, you will be providing yourself with a solid foundation of expertise to rely on when you're ready to get more ambitious and experimental. Because the creative path is often a meandering one, there is no right or wrong place to start. Jump in wherever it looks fun or where the challenges most intrigue you.

Understanding formats. All digital photo formats are not created equal. With a choice of 50-plus formats, it's a good idea to know which one you're utilizing and why. The differences between the formats could have an effect on your work. If you're not sure why TIFF (Tagged Information File Format) would be a better choice than GIF (Graphics Interchange Format) for your meticulous close-ups of spring flowers, or if you think "lossy" is an affectionate name for a farmyard bovine, your first stop should be "File Formats" on page 108 for a crash course on file formats.

Tweaks and touch-ups. So you say that rare four-generations family photo from last Thanksgiving would be perfect if it wasn't for the infernal gleam in your grandmother's bright red eyes. A well-equipped editing program will make short work of the dreaded red-eye effect or zap a late-breaking pimple faster than you can say "Clearasil." In some programs, such as MGI's PhotoSuite, you can take the same tools used to clear up small blemishes and apply them to eradicate entire people, which is better than ripping photos in half after a nasty breakup (Hey, what if you get back together?).

Other basic edits that always come in handy are cropping a picture's edges to create a focal point, resizing or rotating the entire image, sharpening what's slightly out of focus, and fine-tuning the contrast, brightness, and color balance.

Restoration and repairs. As some photos grow older, they become family heirlooms. Unfortunately, their age and delicacy often prevent them from being freely shared. Time may not have been kind to them, either, turning them brittle or leaving them with moisture damage, rips, folds, and even spots where the image is physically disintegrating. Salvage a photo such as this, and the rest of your family will regard you as a miracle worker. For a hands-on tutorial on undoing the ravages of time, see "Restore Damaged Photos" on page 111 and preserve your heritage before it's too late.

Special effects and filters. No matter how artfully it's photographed, sometimes reality can use a little enhancement. If you're prone to thinking more about what could be rather than what is, you'll want to experiment with your program's selection of transformative tools. A well-stocked image editor will provide you with dozens, even hundreds, of ways to end up with a photograph that's noticeably different from what you started with.

On the subtle end of the spectrum, you can use filters to cast a sepia or blue tone over the photo. Other tools are more radical, giving the picture a stark, grainy quality, or blurring the image to create a sense of movement, or twisting it with a swirl effect. Still others can morph a photograph until it appears to be rendered in another medium entirely, such as a chalk drawing or pencil sketch. If you have a steady grip on your mouse, you may want to try hand coloring. For ultimate control, look for tools that let you zoom in on a near-microscopic level and manipulate the individual pixels that comprise the image.

Composites and collages. Here's where your creativity can run wild, depicting events that never happened and lifeforms that don't exist. With each technique, addressed separately in "Tabloid Photography 101" and "Arresting Artwork" on pages 101 and 115, respectively, the basic concept is to combine two or more distinct images into a unified whole, such as dropping a person into a new setting or transplanting heads onto different bodies.

This is one area where going digital can make life infinitely easier. Not all that long ago, a complex, surreal melding of imagery could only be created with multiple enlargers, painstaking work with an airbrush, and zero margin for error. Now, using software, what once took hours can be accomplished in a fraction of the time. The savings in material can be equally substantial. Rather than filling wastebaskets with rejects while striving for that perfect print, all you have to do is click Undo until you get it right.

Printing and archiving. After you've amassed a stash of image files in your PC, what then? After all, they're not really pictures until you can share them. Beginning on page 117, we cap off this series with three articles that will help you coax the best quality photos out of your printer, as well as safeguard your collection for posterity, and even upload it to the Web for public viewing. Sites such as Ofoto.com offer user-friendly templates that will enable you to compile entire albums online, or you may already have a Web site of your own, ready and waiting for visuals.

Give us just a few minutes with some image-editing tools, and we will give you the TurboOwl 2000, just in time for the next Harry Potter movie.

■ **Get Started.** Although digital technology can make many aspects of photography more accessible, expertise is gained only through experience and is well worth the effort. There's something uniquely satisfying about capturing an image that no one else has captured before, then learning how to further shape it so it bears your personality, communicating what you alone want it to say. Photography is a universal language, and fluency begins with your own two eyes.

by Brian Hodge

The Perfect Picture

Edit Flaws Out Of Photos

The development of the graphical desktop environment (from text only) signaled a revolution in photography. Whereas photography buffs were once required to learn sophisticated darkroom techniques or pay large sums of money to have their photos retouched, they can now perform a variety of enhancements themselves. In the last few years in particular, image editing programs have dropped in price and increased in sophistication so much that amateurs now have an assortment of professional digital editing tools at their command for less than $100.

Whether you scan your images with a desktop scanner or shoot them with a digital camera, you can enhance them digitally. The most popular enhancements, which we discuss here, are easy to accomplish and produce amazing results. Cropping and rotating, color and exposure correction, and red-eye removal all are a part of the amateur shutterbug's arsenal when he has a good digital image editor. (For more on choosing an image editor, refer to the sidebar, "Perfect Your Image.") With the tools you'll find in today's consumer-grade image editors, you'll quickly be on your way to creating beautiful photographs that will make even a professional take a second look.

Digital Image Basics. Before you begin the image-editing process, you should consider a few issues.

Size matters. Whether you are scanning or shooting digitally, make sure the resulting image is large enough to match its intended use. Even the best image editors can't increase the size of a small image without reducing its quality.

All digital images are composed of **pixels**, squares of color that, when viewed from a distance, create the illusion of a continuous-tone image, such as a photographic print. The number of pixels used to create an image is referred to as its resolution. Resolution determines how large an image can be before the individual pixels become apparent. Optimal resolution takes into account the monitor's size and the number of pixels displayed per inch. Monitors usually display somewhere between 72 and 96 pixels per inch. So, for an image to be optimally displayed on a 3- x 5-inch monitor, the image needs to have a resolution of 288 x 480 pixels. That number is derived by multiplying the number of inches along one axis (3, in this case) by the density of pixels (96) per inch, and then doing the same thing with the other axis: 3 x 96 = 288 and 5 x 96 = 480.

To create a print from an image, the resolution must be much higher, as professional printers reproduce images at 300 pixels per inch (this is also referred to as dpi, dots per inch) or more. To look good as a print, a 3- x 5-inch image should be 900 x 1500 pixels ([3 x 300] x [5 x 300]). That's 1,350,000 pixels, or 1.35 megapixels.

Most desktop printers are forgiving and can work with 72dpi resolutions. If you find that the quality of images you send to your desktop printer is not good, however, increase the resolution of your images.

Most current digital cameras offer resolution of 1.3 megapixels or higher, but many scanners are set to a default of 72dpi. Resolution directly affects file size: the higher the resolution, the bigger the file. Don't use high-resolution settings unless you need to. Do, however, create the initial image (scan or camera) at the highest resolution you may ever need.

Mistakes needn't be permanent. Most image editors offer an Undo command that lets you revert back to an image's previous state if you decide you do not like the results of an action. In most Windows programs, the Undo command has a shortcut: CTRL-Z. Depending on the program and its preferences, you may be able to undo as many as 99 actions with this key combination.

The more actions you can undo, the more changes a program must track. This increases the amount of hard drive space an open file will temporarily consume, which will slow your system down. But if you are performing numerous and complicated edits, the trade-off in performance is worth the flexibility you gain.

In most programs, if you have already clicked OK in a dialog box to accept an action, you can still undo that or previous actions. If you save a file or rename it, however, all the Undo information that has been stored up to that point will be lost.

Don't be afraid to experiment. Although the learning curve of a new program can be steep, the rewards of making sure you are happy with your image editor are worth the time involved in picking the right one. All the editors we will discuss offer at least a free,

limited-feature trial. Experiment to your heart's content before you plunk down your cash.

For the examples in this article, we chose Jasc's Paint Shop Pro, a reasonably priced ($99 Web download), yet feature-laden, winner that is comparable to Adobe Photoshop (http://www.adobe.com), which is the tool of choice for most graphics professionals. You can download and use PSP for 30 days without paying a penny, and doing so may help you better understand the examples in this article. For your free download, visit http://www.jasc.com and click the Free Downloads button near the top of the page.

■ **A Healthy Crop.** One of the most useful features of image editors is the cropping feature, which lets you remove extraneous information around an image and concentrate the focus of the image on your subject. This feature is particularly useful when scanning prints, where you can increase the size of the scan to account for the enlargement. For example, if you plan to crop a 2- x 3-inch area out of a 3- x 5-inch print, scan it at 200%. After cropping, your new image will be 4 x 6 inches, slightly larger than the original 3 x 5 inches.

Most image editors support cropping via the **marquee** tool. Here, the user draws a dotted line around the new image and chooses a crop option from a toolbar or menu. This action removes the area outside the marquee. More sophisticated image editors, including PSP, also offer a cropping tool that looks similar to two overlapping uppercase Ls placed at a diagonal from each other with a thin straight line running through the middle.

To use this tool in PSP, select it from the main toolbar, position it at the corner of the area you want to keep, and drag it to the opposite corner to create a selection. To adjust the area, either click and hold inside the box and drag the box with your mouse, or position your mouse pointer on the edges of the box and click and drag to resize the box's coverage area. Once you are satisfied with the selection, move your mouse to the Tool Options – Crop palette that appears at startup and click the Crop Image button.

The amount of an image that should be cropped depends on the preferences of the person performing the edits. Some people prefer not to crop out hands or feet, for example, while others want to zoom in on the subject's face as much as possible. Consider the example photos shown in Figure 1. Although the trees and fence are attractive and atmospheric, they detract from the main subjects: the house and the woman in front of it. A nice balance between subject, house, and trees would be a good choice for the final product. In this case, we cropped the image so the house was framed, but by only the closest tree branches. We cropped out the subject's lower body so the head and shoulders became the focus.

■ **Rotation.** If the subject of a particular photograph is placed against a backdrop that has an angular or square shape and the photographer is not careful when he snaps the shutter, the background may appear crooked in comparison with the foreground subject. Such is the case with Figure 1 in the preceding step: the house appeared to dip down from left to right. Although this effect was barely noticeable in the original image, it became more pronounced once we cropped the image. The cropped image was then rotated slightly using PSP's Rotate command. This action straightened the house and eliminated the problem.

Figure 1. Before cropping (top), the beautiful but distracting surroundings overwhelmed the subject in the image. Cropping the original image (right) gave it the desired focus (the house and woman in front of it).

To rotate an image, select Rotate from the Image menu and select a small percentage, such as 1%, and enter it in the Free dialog box. Click Right or Left depending on which way you want the photo to be rotated. Repeat if necessary (enlarging the rotation percentage if you wish) until the background item appears straight. After the rotation is complete, crop out the uneven edges that appear around the rotated image.

■ **Color Correction.** Color correction, the adjusting of the hue and tone of an image or its components, is a task that was once left to graphics and photography professionals. Most image editors for the consumer market, however, now offer tools that let the average user perform a variety of color modifications.

Color channels. The easiest color corrections to perform are those that change the color balance on an entire image. Different lighting environments, such as fluorescent, incandescent (standard light bulbs), or outdoor light change the appearance of various colors. You can adjust the overall tone of an image to compensate, at least in part, for the color variations that result from shooting in different lighting environments.

Image editors break all images down into **channels**, the layers of color that make up the composite image. The channels in the images you view on a monitor, for example, are RGB (red, blue, and green). The channels in the images you see on a printed page, by comparison, are CMYK (cyan, magenta, yellow, and black).

Imagine stacking three or four different colored pieces of transparent film on top of one another. If you looked through the stack of colors, each layer would contribute a portion of the final color you would see. This is how channels work, as well.

Change channels. Most image editors provide several methods for correcting composite and single-channel color. Each of these methods takes a different approach but can be used to achieve the same basic effect. Which tools you use for color correction will depend upon personal preference and the problems the particular image presents. Plan to spend

Figure 2. Changing the color balance in the original image of the Dalmatian increased its richness and restored red tones (right) that the flash had washed out (left). The final result was also cropped to remove the blanket at the top of the image.

some time experimenting with your image editor to find the method that produces the best results in a variety of circumstances.

PSP offers an array of options under its Colors menu. Those that relate to color balance and intensity are located under the Adjust option. Other choices on this menu, including Colorize and Posterize, are for special effects rather than color adjustment. In many cases, the easiest color adjustment tool to use is Color Balance. Most other image editors offer a comparable feature that may also be called Balance.

Balance it out. To open this tool in PSP, select it from the Adjust option on the Colors menu. When the window opens, you will be presented with before and after views of a portion of the image. PSP will automatically evaluate the color and offer its suggested color correction in the second window. If you want to see how the changes affect the original image, click the Auto Proof option (the Down arrow next to the eye in the center of the dialog box).

You can accept PSP's suggested adjustments or make additional ones. Alterations are made via slider bars that the user moves back and forth to change the overall tone of an image from red, green, or blue to its respective opposite: cyan, magenta, or yellow.

A different tone. At the bottom of the Color Balance dialog box you will find a section called Tone Balance. It contains three buttons: Shadows, Midtones, and Highlights. Midtones is selected by default because the color of an image is most noticeable in the middle range, where it is neither very light nor very dark. If you have an image with color problems in the shadows or highlights, you can change the selection and edit those colors, as well.

Note the Preserve Luminosity checkbox. This feature keeps the brightness between the original pixels and the edited ones. If you wish, view the image with the box both checked and unchecked. Generally, unchecking the Preserve Luminosity option results in a flatter, less vibrant final result. It affects image output and should be left checked.

In the image of a Dalmatian that we chose for our color adjustment example (Figure 2, left), the light in the room, combined with the flash effect, has washed out the color in the foreground and given a greenish cast to the overall tone, making a purple sweater appear blue and a red pine floor appear yellow. The color correction PSP suggested is a starting point, but it does not fully correct the color in this image. In this case, the color balance on all three tone options—Shadows, Midtones, and Highlights—was altered. (For a better finished product [Figure 2, right], the blanket in the top of the image was also cropped out.)

■ **Adjust Exposure.** If the color of an image is fairly accurate but it is too light or too dark, there is too little or too much contrast (the difference between the lightest and darkest areas), or the color is too vibrant or too washed out, you can adjust the exposure to correct these problems.

In a different light. Most image editors (including PSP) offer their exposure adjustment tools on the same menu with the color adjustment tools. In PSP, this is the Adjust option on the Colors menu.

Several tools alter the intensity or lightness of an image, including Brightness/Contrast,

Perfect Your Image

Image editors range in price from free to over $500. What you pay for is not necessarily what you get. As we mentioned earlier, Paint Shop Pro approaches Photoshop in functionality for about one-fifth of the price.

Features to look for in an image editor, in addition to the operations discussed in this article and support for scanners and digital cameras, are **layers** (dividing an image into its component parts and performing operations on each part without also editing the others), **masks** or alpha

Product	Manufacturer	Cost	Scanning/Cameras	Crop/Rotate	Correction
Paint Shop Pro (http://www.jasc.com)	Jasc	$99	Yes	Yes	Yes
CorelDRAW Essentials (http://www.corel.com)	Corel	$79	Yes	Yes	Yes
Lview Pro (http://www.lview2.com)	MMedia Research	$41	Yes	Yes	Yes
PhotoExpress, My Scrapbook Edition (http://www.ulead.com)	Ulead	$29.95	Yes	Yes	Limited
The Viewer Pro (http://members.aol.com/brandyware)	Brandyware	Free	Yes	Yes	Yes

Hue/Saturation/Lightness, Highlight/Midtone/Shadow, and Levels.

Brightness is a measurement of the intensity and **luminescence** (light-reflecting capabilities) of the colors in the image, and contrast reflects the range between the lightest and darkest colors. **Hue** is a function of a color's location on the spectrum (changing the hue of an image changes its coloration), while **saturation** is a measurement of an image's richness—how far from a black-and-white image it has moved. **Lightness** is a measurement of how much white or black is mixed into the color palette used to construct the image.

The first two aforementioned tools are used to alter the appearance of an image based on the respective criteria of the tool. The third tool, Highlight/Midtone/Shadow, lets the user change the balance between the light-, medium-, and dark-toned portions of an image. The fourth option, Levels, alters the amount of color, either composite or a specific channel, input to the image (from the digital file) or output from it (to the printer). This has the effect of changing the color intensity of the image. All of these are valuable adjustment tools. Play with them until you have a feel for their capabilities.

In action. In Figure 3 (left), a French Quarter balcony appears washed out by the bright sun. Adjusting the lightness and the saturation will restore much of the original color. For this task, you would use the Hue/Saturation/Lightness tool.

When you open this tool, PSP will provide before and after windows with portions of the image displayed and then automatically make a recommendation about the adjustment (as it does with other tools). In the case of the balcony, PSP's recommendation is for increased saturation, but it is hard to tell if this will be a suitable solution without viewing the entire image. Turning on the Auto Proof tool will apply the suggested edit to the entire image. (You could use the Zoom tool to change the view in the image samples displayed in the Hue/Saturation/Lightness dialog box, but the larger, enhanced image is easier to evaluate).

Figure 3. The original balcony shot (top) was washed out by bright sun. After making minor exposure adjustments (saturation, lightness, hue, brightness, and contrast), the image became much more vibrant (bottom).

PSP's recommendation (Saturation of 18 and Lightness of 0) is a little too vibrant in this case. A setting of 14 is better. In addition, the color is slightly orange. Adjusting the Hue slightly (to a setting of 8) shifts the color toward the green range and enhances the appearance of the foliage. Finally, darkening the image slightly (to a Lightness setting of -5), further brings out the color in the flowers and foliage (Figure 4).

To make the colors (and the transitions between them) crisper, you could now use the Brightness/Contrast tool. PSP does not make a recommendation with this tool, but by playing with the percentages (click and hold the large down arrow to use the pop-up slider bar), you would further define the image. In this case, a setting of Brightness 13 and Contrast 19 produces very satisfactory results. The new balcony image (Figure 3, right) now looks much better, more colorful than the original.

■ **Red-eye Reduction.** Red-eye, in which the subject of an image appears to have red eyes, is caused by the reflection of a camera's flash on the iris of the subject's eyes. Most image editors have a red-eye removal feature that removes (or covers) from a selected area

channels (creating special overlays that can contain text or other images), a text tool (adding text to your graphics), and special filters and other artistic effects that can alter your images in creative, new ways. Also consider if the package has unusual features that give it an edge.

The chart below provides a rundown of the top under-$100 image editors and their features. If you have more money to spend, consider Photoshop or CorelDRAW! (full version).

Red-eye Removal	Layers	Masks/Channel	Text Tool	Filters/Effects	Color/Exposure Extras/Notes
Yes	Yes	Yes	Yes	Yes	Wide range of special effects and extras.
Manual	Yes	Yes	Yes	Yes	Powerful photo-editing and drawing/page layout package.
Manual	Yes	Yes	Yes	Yes	Supports editing/exporting/importing drawing formats.
Automated	No	No	Yes	Yes	Comes with frames, backgrounds, and clip art to create photo scrapbooks.
Manual	No	No	Yes	Yes	Supports and converts dozens of multimedia formats. Does NOT support long file names.

within the image what the program perceives to be red-eye. You can also use this feature to enhance or change the color of a subject's eyes, even if they are not red.

How well an automatic red-eye removal feature works varies from one image editor to the next. Some automatically locate the area and make the adjustments, while others let you select the area to be altered. If you frequently have red-eye problems and are picky about the quality of your edited images, you should look for an image editor that provides a measure of control over the process. If your image editor does not offer a red-eye reduction tool but supports pixel-by-pixel editing, you can remove red-eye manually, but this a painstaking process.

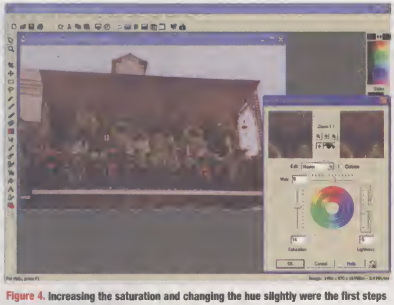


Figure 4. Increasing the saturation and changing the hue slightly were the first steps in enhancing this balcony photograph that the sun washed out.

New set of eyes. PSP's Red-eye Removal tool offers different selection tools for human (round) or animal (oval) pupil shapes and lets you refine your work by selecting the pupil with a freehand drawing tool or a point-to-point tool and performing detailed edits. You can adjust the iris size and pupil lightness of the subject's eye, add and edit the glints in the eye, and blur or feather the selection if necessary to avoid an obvious delineation between the new color and the surrounding area. (Feathering builds a transition between two areas of unrelated color.)

To open the Red-eye Removal toolbox, click the Effects menu and click Enhance Photo. From the drop-down menu that appears, select Red-eye Removal. The Red-eye Removal toolbox will open, showing you before and after versions of the image.

On the left side, in the Method field, the default should be Auto Human Eye. Try this method first. In the center of the toolbox is a zoom tool. Zoom in on the subject's eye until you can see the edges clearly. On the right side, under Hue, choose the color of the subject's eyes (or the color you want to make them). Beneath the Hue menu is a box that contains an enlarged portion of an eye. This color of the eye will change as you change the Hue color selection. If you click the bar next to the close-up, you will be presented with a palette of shades from which you can chose for that particular color.

Eye to eye. Position the mouse pointer over the close up of your image on the left-hand side and the mouse pointer will become a crosshair. The crosshairs marks the center of the area you will edit. Click the center of the eye and drag your mouse outward to create a circular selection. When you release the mouse, the right-hand window will be updated with a photographic rendering of an eye (iris, pupil, and glints) that matches the area you have selected. Click the Auto Proof tool to see your changes reflected in the original image.

Figure 5. Removing the annoying red-eye from the original image (left) made the subject much more appealing and natural-looking.

Adjust the box that surrounds the selected area by moving it (click and drag) or by changing its size (click and drag the handles). After you have all the red in the center of the eye covered, adjust the Iris Size, Pupil Lightness, Glint Lightness, Glint Size, and Feather options until you are satisfied with the results. You should not need to use the Blur option although you can experiment with it if you wish. In the image of the girl chosen for this adjustment (Figure 5, left), the subject's brown eyes were restored successfully with a Hue of Brown, a Pupil Lightness of 10, a Glint Lightness of 60, a Glint Size of 40, an Iris size of 3, and a Feather of 1 (Figure 5, right).

Once you are satisfied with the first eye, repeat the process with the second eye. Click and hold the intersecting arrows in the center of the zoom option and move the mouse to re-center the image. Make adjustments to the settings if necessary. For the subject used in the example, the same settings worked beautifully for both eyes.

■ **Higher Learning.** The techniques discussed in this article will take you a long way on the road to beautiful, professional-looking photographs. When you have mastered them, you will probably be ready to discover what else you can do to alter your digital images. From helping you restore damaged photographs to making your images resemble watercolor paintings, a broad array of effects and alterations can be achieved with today's image editors. With one of these programs in your collection, all you'll need to obtain amazing results from your images is a little imagination and a few hours' time. LS

by Jennifer Farwell

Tabloid Photography 101

Digital Sleight Of Hand Produces Photo Composites

You're waiting in line at the supermarket. You're bored, so you peruse the tabloids. The headlines are incredible:

"Julia Roberts & BIGFOOT! When It Comes to Romance, He's All HANDS."

"Alien Baby with the Head of Robert Redford Lands on Earth!"

"Why is Burt Reynolds' Face Sprouting Daisies?"

These are amazing, and there are pictures to back up the claims. How did those tabloids get those pictures? Interested photographers want to know!

Truth be told, photos such as these are not taken; they're made. They're actually composites of multiple pictures doctored in such a way to look like one legitimate photo. To produce a photo composite, you need a little creativity, knowledge of the tools available on your image editor, and lots of patience. That's because complex composites can take hours to create.

In this demonstration on how to make a composite photograph, we will refer occasionally to the image-editing program Paint Shop Pro. If you use a different image editor, make sure it can support layers. A layered image is a stack of individual images (such as a picture of Julia Roberts and one of Bigfoot) that, once pressed together (a technique known as flattening), creates a single image (look, they're a couple). By placing each picture element on its own layer, you can select any individual layer and modify it without affecting the rest of the image. Commands between PSP and your image editor may vary slightly, but the concepts in making a successful composite will remain the same.

Quick & Dirty Composite. A simple composite can easily be made by selecting the subject you want to add, copying the selection, and then pasting it into another photograph, as shown in Figure 1.

Within PSP, click the Freehand selection tool. Begin tracing around your subject by dragging the cursor around what you want to select. Once you've completed the trace, a flashing marquee will appear around your subject. This is your selection. Press CTRL-C to copy that selection. Now, open the file that will receive your selection, click the Edit menu, point at Paste, and choose As New Selection. Your selection now appears floating over the new photograph. Move it to the desired location, and once situated, click the Selections menu and choose Select None. Congratulations, you've just made your first composite. Quick, call the *National Enquirer*.

Fool The Viewer. If you're trying to create a collage, such as the Beatles' Sgt. Pepper album cover or the one shown in Figure 2, the quick and dirty technique may work fine. But if your goal is to give Tori Spelling a second head, a simple cut-and-paste won't even fool the editors at the *Weekly World News*.

Fooling your viewer requires you to consider all the properties of every image that constitutes your composite. Compare lighting, color, shadows, size, and print quality. You'll need to alter your images for every property discrepancy. The more fastidious you are, the better your composite will look.

The right photos. The most important part of an easy and successful composite begins with the choice of photos. Some images just don't belong together: photos shot at different viewpoints, for example. A person shot from above with top-down perspective combined to a photo shot at ground level with horizontal perspective will never appear believable. The same applies with wind conditions. If you have a group shot and only one person's hair and clothes are blowing, that person will stand out.

Your image editor can't simply fix such discrepancies. Use this rule of thumb: If you have to redraw it, don't use it.

Photos can be resized, though, and you'll need to resize a pasted-in photo to look proportionate to other objects in the picture. Be careful when enlarging photos. If you make an image too big, you'll get unavoidable jagged edges. Apply a blur effect or choose the Retouch brush with Soften selected to lessen the impact.

Lighting. If the composite is set outdoors, remember: There's only one sun. Watch the shadows. Your two subjects may have been shot at different times of the day. To fix pictures so they look as if they were shot at the same time, you may be able to simply flip one image. Before you flip, make sure there are no attributes, such as lettering on clothing, that would make the flip impossible.

You'll still need to adjust the brightness and contrast given that sun in the morning and

Figure 1. This quick and dirty composite is easy to create. Take a picture of your background (left), cut your subject out of another picture (middle), and paste him on top of your background (right). It won't fool anyone, mind you, but it's one way to put yourself anywhere in the world.

afternoon doesn't necessarily produce the same results. If you have an image that's overexposed, you'll want to lighten the other image to match. Making an overexposed image darker is difficult, if not impossible.

To pinpoint a shadow or shine on your subject, activate the burn and dodge brushes. Found under the Retouch tool on PSP, the brushes respectively let you decrease or increase brightness of certain sections.

Your subject may be wearing a red shirt, but as any Impressionist painter knows, different light on the same subject will produce different colors. The most notable differences are between indoor and outdoor light. Warmer, indoor light produces an orange tint while cooler, outdoor light yields a bluish tint. Air

Figure 2. Collages can be made up of dozens of layers of images. No effort was made to erase the seams between these images.

conditions, including haze and fog, will also change colorations. If you place two subjects together that were shot in different light and atmosphere, you'll have to adjust color and saturation. **Saturation** defines the level of tint in your picture. Move saturation up to make colors more vivid. Slide it down if you want to make the colors grayer.

Everything in focus. Don't be fooled by the Sharpen filter. It won't focus an out-of-focus picture. The Sharpen filter only increases the distinction between contrasting pixels. It can actually be detrimental to image quality as noise elements become more pronounced.

Hollywood execs know that it's easier to make Julia Roberts look like a troll than to make a troll look like Julia. The same principle applies to your composite. It's easier to turn something beautiful into ugliness than trying to convert something ugly into a masterpiece. Find the lowest common denominator for your photos and then bring the elements down to that level. Instead of trying to focus a blurred picture, blur the other picture that's in focus.

If the target photo has a short depth of field, elements appearing just 1 foot behind the focused subject will be out of focus. Depending on how far you place your selection in the background, you need to blur either the whole image or just the edges with the Retouch tool to match the other objects appearing at the same distance.

■ **Like Film.** To make a digital image look like a film print, add some noise. Photos produced from film have a rougher grain than those produced with your digital camera. The size and shape of that grain becomes pronounced when the picture is enlarged or scanned.

In PSP, select Effects, Noise, and Add. Enter the percentage of noise and, depending on the image properties you're trying to emulate, select Uniform or Random. Click OK. If this doesn't give you the desired effect, add a blur effect.

Be selective in how you apply your effects. An effect across an entire image usually doesn't work well. Focus your noise activity using a selection tool or the Retouch brush.

■ **Seamless.** Noticeable edges are the first sign that you've created a composite. If you're tracing an individual, it's impossible to make a perfect selection. This is due to an unsteady hand and antialiasing. To reduce jagged lines, **antialiasing** adds semi-transparent pixels along the edges. These pixels include unwanted colors from the original background. Even if you could make a perfect selection, once pasted against the new background, these edges become obvious.

Your first step is to contract and defringe. **Contract** reduces the size of the selection by the number of pixels you define. **Defringe** will eliminate the remaining background color pixels from the edge of your selection. In PSP, you need to first Float the selection by clicking Selections menu and then Float. To Defringe, go back to the Selections menu, click Matting, and click Defringe. Enter either 1 or 2 pixels of edge width for defringing and click OK. This will hopefully eliminate the color fringe. Repeat or undo if necessary.

You'll often need to contract and defringe even with Magic Wand selections. The **Magic Wand** makes seemingly perfect selections by automatically grabbing a given area based on a selected color tone. If your subject sits on a solid background, such as stock clip art, click anywhere on the background. This instantly selects the background. To select your subject, just invert the selection (select Invert in the Selections menu). Even though the selection may look perfect, contract or defringe it by a couple of pixels to eliminate any antialiasing effects.

Now that your edges are clean, do they look right for the destination photo? If you're pasting a slightly faded selection into the foreground of a very clear photograph, you'll want the edges to be crisp. Choose the Retouch brush and set it to Sharpen. Paint around the outline of your selection to get the desired effect.

This will only sharpen the outline. To enhance outlines within the image, such as facial features and eyeglasses, select the Effects menu, choose Sharpen, and select Unsharp Mask. Unlike Sharpen, which intensifies all pixel contrasts, Unsharp Mask only enhances pixels that reach a certain level of contrast. A level you can define within the Clipping option.

Most often you'll want to smooth the edges. As with the above example, choose the Retouch brush, but this time set it to Soften. Paint around the selection to blend your image into the background. If you are taking a subject from a background that is similar to the destination background, such as a grass field, try feathering your selection. **Feathering** fades the edges to create a seamless transition from the selection to the background. Try smoothing the edges to improve the feathering effect.

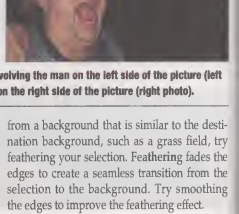


Figure 3. Before we can make a composite image involving the man on the left side of the picture (left photo), we needed to remove the image of the man on the right side of the picture (right photo).

Figure 4. As with Figure 3, we used Paint Shop Pro's tools to isolate our subject.

■ **Abracadabra! You're Gone.** Pasting a new subject in an image usually requires you to get rid of another subject first. If you want to make yourself Jennifer Aniston's new boyfriend, you're going to have to get rid of Brad Pitt.

If the image of Jennifer and Brad has a solid background, select the background color with the Dropper tool. This will change the color of the paintbrush to the background color. Now, paint over Brad Pitt.

If the background is more complicated, you'll have to clone it and use that as your paintbrush to get Brad out of the picture. The **Clone brush** continually copies a specified part of an image as you move the brush. Be patient with the Clone brush. It takes time and skill to do it right. But it's worth it for Jennifer.

In both Figures 3 and 4, we took advantage of the solid background and eliminated, the variables from the pictures of our main subject. In Figure 5, we combined the end results of Figures 3 and 4 to make a composite that the *Weekly World News* could run with the headline "An Exclusive With Santa's Secret Siamese Son: 'Dad Always Liked The Other Kids Best'."

■ **Mask Selections.** Another method of selecting an image is to apply a mask. A **mask** is a grayscale image that covers up the portion of the layered image you don't want to see and reveals the portion you do want to see. Black areas hide while white portions reveal the masked image. And if the mask is gray, the image underneath becomes semi-transparent.

A mask lets you capture more difficult selections. The Selection tool offers limited editing options. You can modify any masked selection using any grayscale paintbrush tool or effect.

To apply a mask in PSP, make your selection with the Selection tool and then select the Masks menu, New, and Show Selection. If you want to edit the selection, select View Mask from the Mask menu and then go back to the Mask menu and choose Edit. You'll see a red-tinted over your selected image. This is your mask. Editing your mask with any of the paintbrush tools changes your selection. Remove the red, and you reveal the image underneath. Paint more red and you hide more of the image underneath.

Masks give you more control over your selection. You keep the entire image even if you only use a portion. It's easier to edit than using just the Selection tool alone, and you can apply fade effects by applying gray tones to the mask.

■ **Studio Shoots.** You'll most often create composites out of existing photos. But if you're lucky enough to get some studio time with your subject, you'll want to shoot him against a solid-colored background.

The ideal background is a blue screen. But if you can't get a blue screen, any solid background will work. Once you've developed the image, select the Magic Wand and click the colored background. Invert the selection and your subject will be selected. No tracing necessary.

■ **The Move To Video.** If your tabloid starts a TV show, you will need to learn video compositing. Using a combination of layers and masks, video composites are similar to print ones.

Because creating selections by hand for video would be impossible, a video masked selection is made in real-time using a blue screen. Your subject, such as the weatherman, appears in front of the blue screen. This is your first video source. Another video source, the weather map, is keyed in so it appears only in the blue portions of the wall not covered up by the weatherman. If the weatherman moves forward, Kansas disappears. When he moves back, Kansas reappears. The weatherman is like a constantly moving black mask, and the blue screen is the white area letting the second video shine through.

A video composite requires your weatherman not to wear anything that's the same color of the screen. If he does it'll look as if Wichita is running through his chest. This is usually not a problem because the color of blue chosen for the screen is unique and rarely found in clothes. And the screen doesn't necessarily need to be blue. It can actually be any color, such as green.

For a video composite, the screen needs to be uniformly lit so the screen's color stays consistent for the key, and although the subject is right in front of the screen, he has to be lit differently to match the scenario being presented in the second video source. Lighting with blue screening is a critical issue because blue spill from the wall can shine on the subject. Be patient. Finding the right mix takes some time.

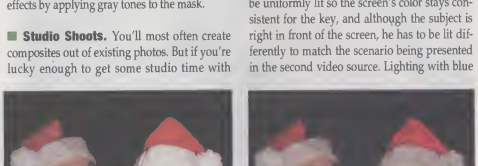


Figure 5. As you can see from the photo on the left, just combining the two pictures of our subject did not give us a balanced composite. We had to adjust the brightness, contrast, and color of the jacket, face, and Santa hat on the man on the right to balance out our photo. None of this, however, explains the mysterious hand on the shoulder of the man on the left. We'll blame that on aliens with man hands.

■ **Put Yourself Anywhere.** Creating quality composites takes time, patience, and creativity. Passing a composite photo off as legitimate is not ethical, but the stories sure are interesting. Now think about what news you can *create*. Tobey Maguire's in the news. Are you sure he doesn't have a second spider head? LS

by David Spark

Effective Effects

Stylize Your Images With Fun Filters

When you click your image editor's Effects menu, do you wonder what all of those options are for? Perhaps you have tried a few of those automated filters, such as Sharpen, but you have hesitated to try any of the others because you don't know how to use them.

If you want to learn more about the filters and effects available, take a few minutes to peruse this article and learn about useful filters that enhance and correct your images. While you're at it, you can learn about some fun and interesting effects, too.

Before We Begin. Most image editors on the market include filters that you can use to quickly enhance and transform your images. With just a few clicks, you can take a photo and sharpen it, make it resemble a watercolor painting, or even add a spotlight effect to it.

The location of the filters varies depending upon the software that you use. For example, Photoshop LE (Limited Edition) places filters in the Filters menu, whereas Paint Shop Pro and PhotoDeluxe place filters in the Effects menu. For simplicity, we'll use the term "Effects menu" throughout this article, unless we are discussing a specific editor that uses a different convention.

Also, keep in mind the following recommendations:

- If you apply a filter to your image and decide you don't like that filter, click Undo in the Edit menu (or press CTRL-Z). If you return to the filter setting and adjust it without clicking Undo first, the editor builds on the adjusted image.
- Be sure to use the thumbnail previews that most of the filters offer. This decreases how often you have to click Undo in order to reverse the effect of a filter.
- Whenever possible, avoid using automated filters (those that do not offer settings you can adjust). You get better results from filters you can control.
- Keep in mind how you want to publish the image file. If your final destination for your image is a print medium, print the image to verify that the quality is acceptable. If you plan to use the image on a Web site, remember to keep the file size to a minimum.

Now that we have covered some of the ground rules, let's get started.

Enhance, Adjust & Correct Photos. The most frequently used filters are the ones that improve and enhance the look of an image. Among other things, filters can sharpen, blur, remove speckles, and add lighting to the photo. Let's begin with Sharpen, which is probably the most useful filter for improving images.

Sharpen the details. Most image editors offer several options for sharpening images. For example, Paint Shop Pro and Photoshop LE offer Sharpen, Sharpen More, and Unsharp Mask. All of these options bring out the details in your image, but they cannot add detail that is not already there. If the original image is more than a little out of focus, for example, sharpening won't fully eliminate the fuzziness.

Sharpen and Sharpen More are the easiest and quickest means of sharpening images. Both options apply an automatic sharpening filter to the image, with Sharpen More being the stronger of the two.

To automatically sharpen an image, first open the image in your editing software. Next, click your editor's Effects menu, point

With just a few clicks, you can take a photo and sharpen it, make it resemble a watercolor painting, or even add a spotlight effect to it.

to Sharpen, and select either Sharpen or Sharpen More. Continue clicking Sharpen or Sharpen More until you are satisfied with how your image looks on-screen. If you over do the sharpening, use the Undo option in the Edit menu.

If you want more control over the sharpening process, use the Unsharp Mask feature. This feature lets you define the distribution of sharpening and the thickness of the edges. Edges are areas of significant color change within the image. When you select Unsharp Mask, there are generally three options available for you to tweak: Strength, Radius, and Clipping (sometimes called Threshold). Strength controls how intensity the effect is aplied to the image, Radius dictates how large an area beyond the edges is affected, and Clipping indicates the fineness of the edge detection.

As a baseline, set the Strength to 100, Radius to 1.0, and Clipping between 5 and 10. Adjust and preview the settings until you are satisfied with the result.

Create misty for me. You can use the blur filters for a wide variety of effects, ranging from a little bit of blur for that foggy or misty look to a lot of blur for complete distortion. In addition, blur filters can add motion to an image, giving the illusion of movement in the picture.

Similar to the sharpen filters, blur filters come in a variety of styles. Common blur filters include Blur, Blur More, Gaussian Blur, and Motion Blur. The Blur and Blur More filters are automatic filters that do not offer much control over the level of blurring. If your editor offers it, a better choice is the Gaussian Blur option.

The Gaussian Blur effect uses a formula, commonly known as the bell curve, which the mathematician Karl Friedrich Gauss devised. The curve determines the distribution of the blur effect.

When you select Gaussian Blur from the Blur options in your editor's Effects menu, a dialog box displays. The dialog box includes a Radius slider. For a softening effect, adjust the slider to 1.5 or less. For a more pronounced effect, use values between 1.5 and 5. Values more than 5 completely distort the image. Figure 1 shows the result of the Gaussian Blur at a Radius of 1.

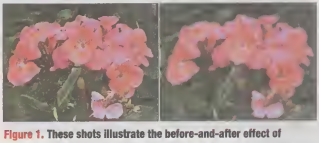


Figure 1. These shots illustrate the before-and-after effect of applying the Gaussian Blur filter to give your image that misty look.

Add perspective. Most images have a focal point. As professional photographers know, you can blur the background to add emphasis to the focal point and depth to the image. This technique also augments the effect of sharpening filters. This is especially helpful when your original image is too blurry to be corrected completely through the sharpening filters.

The first step is to select the area of the image that you want to remain in focus. Zoom in to enlarge the image to more precisely select your focus area. Next, click your editor's freehand or lasso selection tool, which lets you use the mouse as a pencil to outline the selection area. If you have an option to feather the selection, set Feathering at about 5. This softens the line between the focused and blurred areas.

After you define the selection area, the next step is to inverse your selection. Inverse is an option often found in your editor's Select menu. After you click the Inverse option, select Blur from the Effects menu and apply the type and level of blur that you want. For best results, use the Gaussian Blur option if your editor offers it, with a Radius setting of 6 or less. Figure 2 illustrates using this technique.

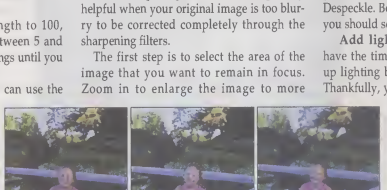


Figure 2. By blurring the background, you can bring out the image's focal point. This technique also makes the focal point look sharper. From our original picture (left), we selected the girl to be our focal point (middle), and then we blurred the background (right) to make our subject stand out.

Eliminate graininess. Your digital images aren't always crystal clear. They can appear grainy when the subject is in low light or is too close to the camera. When a picture is grainy, the picture looks as if small dots are scattered throughout the image; these dots are undesirable when you want a clear, well-defined image.

To eliminate this problem, most image editors include a Despeckle filter. This filter is normally in the Noise category of the Effects menu.

Despeckle identifies the edges in the image and then blurs everything but those edges in order to protect detail. To apply the Despeckle filter, open the image, point to Noise in the Effects menu, and click Despeckle. Because this is an automatic filter, you should see the effect immediately.

Add lighting. Most of us don't always have the time, resources, or expertise to set up lighting before we snap a digital image. Thankfully, you can add lighting to an existing image through the magic of the lighting filter.

With this feature, you can mimic one or more lights, vary the degree of intensity, select different colors, and control the size and shape of the lighting. Figure 3 illustrates how lighting effects can enhance an image and create a focal point.

The steps for using the lighting filter depend upon the image editing software that you are using. For illustration purposes, we'll use Photoshop LE. (For specific steps in other editors, refer to the editor's documentation.)

To begin, open the image in Photoshop LE, click the Filters menu, point to Render, and click Lighting Effects. The Lighting Effects dialog box displays. Position the light by dragging the center to the location that you desire. You can also narrow and widen the light by dragging the handles on the sides.

After you position the light, you can use the Intensity and Focus sliders to control the brightness and scope of the light beam. If you want to change the color of the light, click the large square to the right of the Intensity and Focus sliders. Clicking this box

brings up a window where you can pick colors. If you want to add a light to your image, drag the light bulb beneath the preview window to the desired location.

The Lighting dialog box in Photoshop LE also includes options for changing the overall look of the image (the Properties area) as well as some preset lighting configurations (the Style area). Experiment with these settings to see how they affect your image.

Clean up JPEGs. A number of image editors offer tools to help you improve the appearance of JPEG (Joint Photographic Experts Group) images. The JPEG format uses a compression formula to significantly decrease the size of an image file.

The JPEG compression process can yield **jaggies**, small, block-like areas in an image. The problem can be exacerbated if you enlarge the JPEG image. To smooth this unevenness, you can use a filter such as JPEG Artifact Removal in Paint Shop Pro or JPEG Clean Up in PhotoDeluxe.

For demonstration purposes, we will work with the filter in Paint Shop Pro. To begin, load the image, click Effects, point to Enhance Photo, and click JPEG Artifact Removal. A dialog box displays with options for Strength (Low, Normal, High, or Maximum) and Restore Crispness.

As a baseline, you should start with Normal for Strength and 50 for Restore Crispness. The Strength option dictates the level of automatic correction, whereas the Restore Crispness option controls how much detail the filter should try to re-create. Adjust these levels until you are satisfied with the effect on the image. Note that high Restore Crispness levels may cause small dots to appear in the image.

Figure 3. We used the light filter, an extremely versatile tool, to give our picture of a quilt a more professional look.

■ **Distort, Texturize & Stylize.** You will most often use your filters for correcting and enhancing photos; however, most image editors offer considerably more filters for use in distorting images. These filters are fun to experiment with and can give your images an interesting, graphics-art look. However, make sure that you do not go overboard with the use of these filters.

For ease of discussion, we've loosely classified these filters as distortion, artistic, texture, and noise filters. Your image editor may or may not use these specific categories. In addition, the types of filters that are available in each image editor can vary greatly. However, most editors include at least a few filters in each category.

Distort it. Distortion filters change the shape of an image, transforming the image into a disfigured version of the original (without harming the subject). For example, you can twirl the image, give it a pinched look, make it look wavy, or even add curly-Qs. See Figure 4 for some examples.

Figure 4. Distortion filters vary widely among image editors. Two that were included with our editor manipulated our cat (left) by using the Pinch (center) and Twirl (left) effects. (No cats were harmed in the making of this article.)

Two common distortion effects that you might experiment with are collapsing the image (known as the Pinch effect) and expanding the image (known as the Punch effect). In Paint Shop Pro, these effects are separate options found under the Geometric Effects on the Effects menu. After you click Pinch or Punch, a dialog box displays with sliders that let you control the level of the effect.

In Photoshop LE, click the Filter menu, point to Distort, and click Pinch. The Pinch dialog box includes a slider that controls pinch and punch, as well as a graphical representation of the currently selected level.

Add an artistic effect. The artistic filters give your image the illusion of being created with media such as colored pencil, charcoal, pastels, pencil, sponge, and watercolor. Most image editors place these filters in the Artistic category within the Effects menu. Some editors offer additional artistic filters or sprinkle them among other categories. For example, Photoshop LE offers Artistic, Sketch, and Brush Strokes filters.

Artistic effects that you might find interesting include the Colored Pencil and Sponge effects (Figure 5). We will use Photoshop LE to illustrate how you should apply these effects to an image.

To use the Colored Pencil filter, open your image and click the Filters menu. Point to Artistic and then click Colored Pencil. The dialog box that displays includes three settings.

Pencil Width dictates the width for **crosshatching**, the parallel shaded lines that give the image a penciled look. Use smaller numbers if less crosshatching is desired.

For Stroke Pressure, use lower numbers for more

Figure 5. Our flowers have a new, artistic look after the application of the Colored Pencil (left) and Sponge (right) effects.

background and higher numbers to show more of the image.

Paper Brightness sets the color of the background, or paper. Use larger numbers for brighter or white paper and lower numbers for darker paper.

To use the Sponge filter in Photoshop LE, open your image, click Filters, point to Artistic, and then click Sponge. The dialog box that displays includes three settings: Brush Size, Definition, and Smoothness. For Brush Size, use smaller numbers for more detail. The Definition setting controls the level of color blending. Larger numbers produce less blending. Smoothness controls the level of the sponging effect. Use a higher number for a more pronounced sponge look.

Give it texture. Similar to the artistic effects, and sometimes even intermingled with them, are a group of filters that add texture to an image.

Texture effects can make an entire image or a selection of an image appear as though it has been imprinted on a recognizable material, such as burlap, canvas, bricks, or leather. These filters are generally located under Texture in the Effects menu, and you can use them to create an abstract version of the original image.

Also in this category of 3D effects are edge filters. These filters add emphasis to the edges of an image. Emboss, glowing edges, colored edges, and trace contour are some examples. Edge filters can be found in your image editor's Stylize filters or combined with the Artistic or Texture filters. For examples of texture and edge effects, see Figure 6.

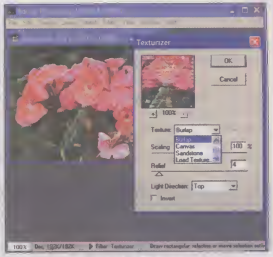
In addition to the wide assortment of texture filters, some image editors also include a texturizer. A **texturizer** is an editing tool that lets you import additional textures, which you can create yourself. The additional texture is simply a graphic or image file that has some type of textured pattern.

In Photoshop LE, for example, Texturizer is an available option when you select Texture from the Filters menu. The Texturizer dialog box includes a Texture drop-down list that lets you choose from different textures that come with the image editor, such as Burlap, Canvas, and Sandstone.

If you wanted a tree bark effect, however, you need to snap an image of tree bark, open the image in Photoshop LE, click Save As, and then choose to save it in Photoshop format (the required format for Photoshop LE's Texturizer). To then use the tree bark texture, click Load Texture in the Texturizer's Texture drop-down list and then select the image file of the tree bark.

Crank up the noise. As we discussed previously, you can use the filters that are in the noise category to remove graininess and speckles from your images. You can also use the filters in this category to do just the opposite: add noise to your images. **Noise** is simply a sprinkling of very small dots over an image. Depending upon the image editor, the dots can be a specific color (monochromatic) or a variety of colors.

You can use noise for a number of purposes. Adding noise to an entire image gives it a grainy texture—an interesting effect by itself and one that adds interest when applied before another filter, such as a blur filter. Noise can also make an image look older, especially if you change the image to grayscale and tint it first to make it resemble an old-fashioned photo. In addition, if you combine portions of different images that have varying levels of graininess, you can add noise to selected areas to even out the differences.



Some of the most interesting filters are in the Texture categories. To add your own texture to the list of effects, select Texturizer from the Effects menu and choose Load Texture in the Texture field.

To add noise to your image, click Noise on the Effects menu and then click Add. A dialog box displays with settings to control the level and distribution of the noise. Unless you want a lot of clutter, a lower setting works best.

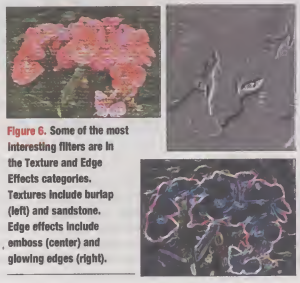


Figure 6. Some of the most interesting filters are in the Texture and Edge Effects categories. Textures include burlap (left) and sandstone. Edge effects include emboss (center) and glowing edges (right).

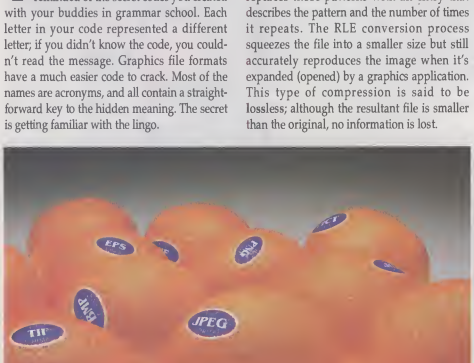
■ **Make Time To Filter.** If you understand how to use filters, the quality of your digital images will definitely improve. Techniques such as sharpening, blurring the background, adding lighting, and eliminating graininess are practical and easy to do. Although you might not use all of the filters your editor offers, at the very least, most images can benefit from these corrective filters. What's more, most of us can think of some fun ways to use some of the less practical but more creative filters. LS

by Carmen Carmack

File Formats

Crack The Code & Learn The Language

The first time you encounter a list of graphics file formats, you may be reminded of the secret codes you created with your buddies in grammar school. Each letter in your code represented a different letter; if you didn't know the code, you couldn't read the message. Graphics file formats have a much easier code to crack. Most of the names are acronyms, and all contain a straightforward key to the hidden meaning. The secret is getting familiar with the lingo.



Each file format was designed for a reason, ranging from application-specific formats that work best (or only) with their native applications to industrial formats designed as standards for the purpose of simplifying data exchange between applications and OSes (operating systems).

All of these formats can store graphics information, but some are better for certain uses than others. Some provide the additional benefit of speeding data transfer by compressing file size. Because compression can be an important factor in choosing a file format, we'll take a closer look at how compression works before we jump into decoding the formats.

■ **Data Compression: Lossless vs. Lossy.** The compression process attempts to reduce the size of a file by removing redundant information. One of the most basic forms of compression, RLE (Run-Length Encoding), looks for repeating data patterns, then replaces those patterns with an entry that describes the pattern and the number of times it repeats. The RLE conversion process squeezes the file into a smaller size but still accurately reproduces the image when it's expanded (opened) by a graphics application. This type of compression is said to be lossless; although the resultant file is smaller than the original, no information is lost.

Lossless compression is not as effective with more complex images, ones that contain a large range of colors and shapes. For these images, a better solution is a compression format that throws away information it deems unnecessary, then re-creates as much of the lost information as possible when the image is viewed. Such compression is said to be lossy because information is lost in the process. In exchange, the file is compressed to a much smaller size than is possible with the lossless method.

Lossy compression is commonly used with color images that have a wide tonal range. For example, a photo of a sunset could be compressed by defining the sky's tonal range at the top and bottom of the sky. All intermediate values would be thrown away. When the file is viewed, the tonal range between the two saved values is extrapolated mathematically to fill in the missing data.

Usually, lossy compression systems let you select the degree of compression to be applied. The more severe the compression, the more information lost and the higher the chance for artifacts of the compression process to appear in the final image.

The choice of compression is dictated by the planned use of the image. When sharing photos with friends and family or posting images on a Web page, data loss may play second fiddle to file size and transfer speed. Lossless compression may be the better choice for line art, images with a limited color range, and images with large areas of common colors. Lossless compression is also the better choice when detail is important.

■ **File Formats.** There are two basic types of graphics files: bit map and vector. Bit maps are used extensively in Web design and some graphic design; vector files have a strong following in CAD/CAM (computer-aided design/computer-aided manufacturing), publication design, and engineering.

Bit maps, also known as raster images or pixel images, break an image into a grid of squares. Each square represents one pixel. Image resolution is defined by the number of pixels contained within a square inch, commonly referred to as dpi (dots per inch). Lowering resolution can result in individual pixels being viewable; raising resolution can result in files of gargantuan size, with little improvement in quality.

Vector files use mathematical formulas to represent an image, in essence defining each line, shape, and color as a set of mathematical properties. As a result, vector images can be scaled and sized as needed, with little, if any, loss of data.

■ **File Types.** Let's look at some of the most common file formats, where they're used, and their strengths and weaknesses.

The Windows OS denotes file type through the use of a file extension, such as .BMP for bit map. Unless otherwise noted, the file extension is the same as the file type.

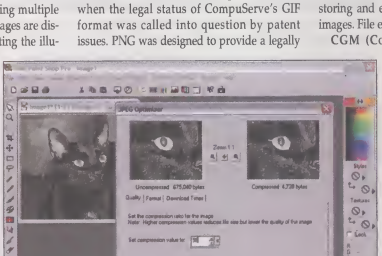
BMP. The native bit map is the file format Microsoft uses in its OS. BMP supports bit maps with 1, 4, 8, or 24 bits of data per pixel so BMP files can be monochrome, grayscale, or full-color. Data can be stored in raw format or in compressed format using 4- or 8-bit RLE compression, which is lossless. BMP format is suitable for line drawings and simple color images.

A common use for transparencies is on Web pages, where the page background can be viewed behind the image.

GIF (Graphics Interchange Format). Developed by CompuServe to compress image files for fast transfer and display on its online service, GIF format is now used extensively on the Internet and is one of three dominant formats for images on Web pages. GIF format supports 8 bits of data per pixel, limiting color depth to 256 colors. GIF files are always compressed, using the LZW (Lempel Zev Welch) encoding scheme. A later version of GIF (GIF89a) supports embedding multiple images within a single file. The images are displayed in slideshow fashion, creating the illusion of animation. GIF89a also supports one-color transparency, which lets you select a single color to represent an invisible area. Wherever this color occurs in the GIF image, the background image (if any) will show through. A common use for transparencies is on Web pages, where the page background can be viewed behind the image. GIF format also supports interlaced images. When an image is interlaced, portions of the image appear in the Web browser as the image is being downloaded, giving site visitors something to look at while they wait for the rest of the page to load. GIF remains a popular choice for storing and transferring low-resolution images and for use on Web pages.

JPEG (Joint Photographic Experts Group). This file format is designed specifically to reduce image file sizes. Using lossy compression, the JPEG compression scheme can produce very high rates of compression, up to 100:1 (before/after resize ratio) or more. But as with any lossy compression system, details can be lost, and artifacts (remnants of the conversion process, such as missing pixels or an abrupt color change) can become pronounced if you attempt to further reduce the file size. Depending on the image being compressed, ratios as low as 10:1 can begin to show artifacts from the compression process. You can select the compression ratio you need so you can choose between file size and image quality. JPEG is used extensively for images on Web sites. Unlike GIF, JPEG supports a full color range and can produce more realistic images, although quality is still determined by the selected compression ratio. On Windows systems, the file extension is shortened to .JPG.

PNG (Portable Network Graphics). Created when the legal status of CompuServe's GIF format was called into question by patent issues. PNG was designed to provide a legally unencumbered, well-compressed standard for lossless bit map files. PNG supports 1 to 48 bits of color per pixel. Its compression scheme produces smaller files than the older GIF standard and can display an image at one resolution while printing it at a different resolution. PNG's patent- and royalty-free nature, combined with its small file sizes, make it an ideal choice for use on Web pages.


JPEG Optimizer
Uncompressed 675,040 bytes
Compressed 4,738 bytes
Quality | Format | Download Times
Set the compression ratio for the image
Note: Higher compression values reduces file size but lower the quality of the image
Set compression value for:
Use Values
OK
Cancel
Help

JPEG (Joint Photographic Experts Group) is a lossy file format. This means some of the image's information will get lost during compression to JPEG. Most image-editing programs will let you decide how much of the information becomes lost.

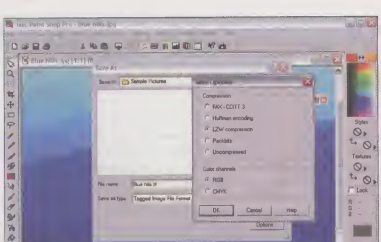
TIFF (Tagged Image File Format). Originally created by Aldus for use with its page design tools, rights to TIFF are now owned and maintained by Adobe. TIFF is a versatile bit map format with support for up to 24 bits of color per pixel and multiple compression formats, including none, PackBits, RLE, LZW, JPEG, and CCITT (Comité Consultatif International Téléphonique et Télégraphique) Group 3 & 4. Most of these formats are lossless, but you can use the lossy JPEG format if you need higher levels of compression. TIFF and its variants are commonly used as the native storage format for digital still cameras, and TIFF is one of the preferred formats for storing and exchanging high-resolution color images. File extensions include .TIF and .TIFF.

CGM (Computer Graphics Metafile). Designed by several standards organizations and ratified by ANSI (American National Standards Institute), CGM provides a standard method for exchanging vector graphics. CGM supports three different file formats: character encoding, for minimal size and speed of transmission; binary encoding, for speed of access during import into a graphics program; and clear text encoding for easy editing. Although bit maps can be embedded within the file, CGM is primarily a vector file. CGM has no built-in compression, although each of the three formats produces different size files.

DXF (Drawing eXchange Format). Developed by AutoDesk for use with its AutoCAD program, this may be one of the most-used vector file formats. DXF is a text-based format that includes support for 3D objects, curves, text, and associative dimensioning. As a text file, DXF is easy to parse (divide into small parts for translating), and many graphics programs include support for DXF format. DXF stores data in noncompressed format, so files tend to be large. As its name suggests, DXF is used primarily for exchanging technical drawings between CAD programs.

EPS (Encapsulated PostScript). A standard format for importing or exporting PostScript language files, EPS files are

typically used in page layout programs, such as Adobe PageMaker and Quark XPress. EPS files can contain any combination of graphics and text, ranging from a single image to an entire page of information. Information stored in an EPS file is in its final form and cannot usually be edited by the importing application, other than to rotate, scale, and place it. EPS files aren't always viewable on-screen when imported, but some EPS files contain an embedded preview image (usually in TIFF), for viewing on systems that don't have Post-Script interpreters available.



When you save an image as a TIFF (Tagged Image File Format) in your image-editing program, the program gives you compression options. Each one of the options saves in a lossless format, retaining more of the image's information.

FPX (FlashPix). Kodak developed FPX in cooperation with Hewlett-Packard and the now-defunct Live Picture. FPX can store multiple resolution versions of an image within the same file. This lets a computer create clear images, regardless of how much a user zooms into or out of the image. To offset the larger file size, FPX uses 20% less RAM when images are viewed. FPX supports uncompressed format, as well as single color compression (lossless) and JPEG compression (lossy).

IPIX. Developed by Interactive Pictures Corporation, IPIX is a format for panoramic images with a 360-degree view. IPIX images are created by joining two hemispherical images taken by a camera with a fish-eye lens. The displayed image lets the viewer move around the image and examine different areas. IPIX format can be used for documenting locations or as part of a marketing system, for example, to let potential buyers view the inside of a new car. IPIX images require a viewer or a plug-in in order to be viewed in graphics applications or Web browsers. The file extension is .IPS.

PCX. Originally created as the native file format for the PC Paintbrush program, PCX became a standard way of sharing graphic files in the early days of MS-DOS. PCX is a bit map format, supporting 1 to 24 bits of color per pixel. PCX files are always compressed using RLE compression (lossless) and are readable by most graphics applications. PCX was designed when there was no standard way to display images on an MS-DOS system. So the format was constantly updated to support new video cards, resulting in multiple versions of the format. For this reason, newer bit map formats are more suitable choices.

PCD. (Photo CD). Developed by Eastman Kodak, PCD was designed for storing 35mm photographs in an easy-to-access digital format. Photo YCC color encoding, also developed by Kodak, compresses and stores data in multiple levels of resolution, allowing up to five levels of resolution per image. PCD is primarily a viewing format, created for display on televisions and computers. Many image-editing programs can import PCD files and save them in other formats.

VRML. (Virtual Reality Modeling Language). VRML is as much a markup language for modeling 3D graphics as a file format. Based on the Open Inventor ASCII file format used on Silicon Graphics workstations, VRML has evolved into the X3D (Extensible 3D) specification for VRML encoding and intends to be backward compatible with the older VRML spec, as well as support newer XML (Extensible Markup Language) encoding. With an appropriate plug-in, VRML lets you view detailed 3D images in Web browsers. VRML includes the ability to embed links within a 3D image that can connect to other VRML images or other Web sites. The file extension is .WRL, meaning world.

WMF. (Windows Metafile Format). A device-independent file format for sharing graphics between the Windows OS and Windows applications, WMF can store vector-based images as well as bit maps and text. A WMF file is actually a collection of GDI (Graphic Device Interface) functions native to the Windows OS. WMF files render correctly regardless of size, making them a good choice for exchanging graphics information between applications.

■ **Decisions, Decisions.** The choice of format is best determined by how the image will be used. If you want to share images with others via email, select a format that allows compression for faster transmission. JPG and GIF are good choices because they're readable by most programs.

If color accuracy is important, choose JPEG over GIF. Although JPEG uses lossy compression, it supports a full range of colors, unlike GIF, which is limited to 256 colors.

For the highest quality image, consider TIFF or BMP; TIFF is the better choice if you plan to exchange images with non-Windows users or send files to commercial printing services.

If the images will be sent out as part of a package for commercial printing, EPS is the established standard.

If the images will be used on the Web, choose one of the three native browser formats: JPEG, GIF, and PNG.

For those working in engineering, CAD, or CAM, DXF is the predominant standard and is readable by the vast majority of applications in this field.

Unless you're sending a file to someone who doesn't have the same application, don't rule out native file formats, which can offer unique advantages for some applications. For example, opening a file in an application's native file format is often much faster than importing a file in a different format.

One final note on exchanging files: To ensure compatibility, Macintosh users should add the appropriate file extension before sending a file to a Windows user.

■ **Your Mission.** Now that you know the secret codes, you're ready to start handling images like a pro. Keep the end use of your images in mind, and before long, you'll be sharing vacation photos with distant friends and relatives or springing them on unsuspecting visitors to your Web site. LS

by Tom Nelson and Mary O'Connor

Restore Damaged Photos

Mend Your Printed Heirlooms

Restoring damaged or faded photographs has long been the domain of highly trained photo retouch artists. Look through the yellow pages of any major city, and you will find numerous professional photo-finishing houses offering to perform this task at prices ranging from a few dollars to $100 or more.

Fortunately for the consumer, the increasing sophistication of image-editing programs has made it unnecessary for him to send old or damaged photographs to be professionally restored. Computerized photo restoration is not a simple process, and it takes time to master. Nevertheless, with a scanner or digital camera, one of several image editors, a little time and patience, and a fairly steady hand, there is no reason why the average user cannot restore damaged photographs on his own.

■ **Choose Your Weapon.** Before you rummage through Grandmother's photo album for potential projects, have your restoration arsenal ready to go.

. **Hardware helpers.** There are two ways for an individual to digitize a photograph: via a camera (either digital or film-based) or via a flatbed scanner. Take a good look at the photograph you are restoring. If it is badly faded or the details are obscured, consider taking the image to a professional scanning service rather than attempting to digitize it yourself.

Professional scan houses use reproduction-quality drum scanners to digitize images. These scanners provide substantially more detail (and therefore better quality) than can be captured by consumer-grade equipment. Using a scanning service is expensive (average $20 to $50 per picture) but may be the best option if you do not currently own a scanner or digital camera or your image quality is poor.

Candid camera. Both digital and film-based cameras can be used to digitize prints. Finding the perfect combination of lighting, position, and exposure settings to accurately reproduce a print without any glare or shadows can be difficult, but once you find that right combination, the results will generally be superior to those you'll obtain by using a scanner.

Immobilize the camera and the image and use a shutter release cable to prevent camera movement. Position the photograph parallel to the camera on a flat vertical surface (a clipboard works nicely). Place them as close to each other as you can (and still maintain focus). Make sure the room is well-lit (do not use a flash) and the light in the room illuminates the photograph evenly without creating any shadows or **hot spots** (reflections).

Take several shots of the photograph, slightly varying both the camera-to-image distance and the **shutter speed/f-stop** (length of exposure/width of lens opening) combination (if you have this option). Make note of the changes you make for each shot and compare them to the finished results to see which combination of settings provides the sharpest picture. If you are using a digital camera, download the images to your computer for further processing. If you are using a traditional camera, take the film to a developing lab that offers photographs on CD and tell them you want high-resolution files.

Plan to scan. Scanning an old photograph is easier than shooting it with a camera, but the finished product may be inferior. The technology used in consumer-grade scanners is not sophisticated enough to capture every detail of a printed image. To obtain the most detail from your scan, set the dpi (dots per inch) to 300 and scan the image at the largest size you might use it. You can always reduce the size of the final file after retouching is complete if you need a smaller file, but you cannot increase its size without losing quality.

■ **Software Secrets.** Several image editors have a tool that will automatically remove minor scratches, dust, and other defects from photographs. In the two programs discussed in the next paragraph, this tool is the Healing brush (Adobe Photoshop) and the Scratch Removal tool (Jasc Paint Shop Pro). Old photographs, however, frequently have large areas of damage in areas of substantial complexity and cannot be effectively repaired with these automated tools.

Restoration of large or highly detailed areas requires professional-level work using these four essential features of image restoration:

- **Cloning tool:** Lets you copy portions of an image and then replicate them in a target area as if you were painting with a brush. You can also clone from one open image file to another.
- **Layering capability:** Creates new work spaces that overlay the original (background) image. When you draw on a layer, the **pixels** (squares of color that make up an image) appear on top of the background image but remain separate from it, as if they were being painted on a piece of clear acetate that had been placed on top of the original image. If you make a mistake on a layer, you can erase it without affecting the original drawing. Layers should have an **opacity** setting. Reducing a layer's opacity makes it become transparent, which lets

the layers and background beneath it show through. This has the effect of blending two areas together. Only when you use the Merge command to combine the layers are pixels from individual layers overlaid onto the background image.

- **Feathering option:** Makes the edges of an image, selection, or brush gradually fade to transparent. This helps reduce the delineation between one item in an image and another that has been placed next to or on top of it.
- **Custom paintbrush option:** Lets you customize the size and color of your brushes (the tools that apply strokes of colored pixels to an image when you click and move your mouse). This should offer brushes that are clearly defined (round), as well as brushes with fuzzy edges. Fuzzy-edged brushes are feathered, blending the new pixels with the old. The brush option should also have an opacity setting. If you are blending an area that is slightly different in tone, reducing the opacity will change the tone of the pixels you are adding.

All of the operations that we will perform in this article are done via Photoshop, but PSP contains comparable features.

The Science Of Cloning. The most important tool to you as a photo-restoration artist is the cloning tool, which is very useful for re-creating lost areas of an image. For example, in the image restored for this article (original shown in Figure 1), we used the cloning tool to restore the missing pixels in the dress and around the edges of the photo and to erase the scratch across the woman's right eye.

Figure 1. Old photographs with substantial damage, such as the one used as our example, can be repaired digitally by users with a little time and imagination.

Match game. To restore a section of missing information, zoom in (CTRL-+) on the general vicinity where missing pixels are located. Look for an area that is similar in tone and texture to the missing section (look adjacent to the section where pixels are missing). Click the cloning tool and position the cursor (now a rubber stamp) over the area you are going to clone. Press ALT and click to set the area as the area as reference (source) point.

Brush the right strokes. Choose a feathered-edge brush from the Brushes palette and move the cursor to the area to be restored. Click the area. A dab of pixels exactly matching the source pixels will appear under your mouse. To draw a swath of pixels, click and hold, then move your mouse slightly. Be careful how far you move the mouse, especially if you are copying from a source area that changes tone or texture frequently (for example, from light to shadow). By default, the source will change as you move your brush, and it is easy to move into an area that no longer contains the pixels you want to replicate.

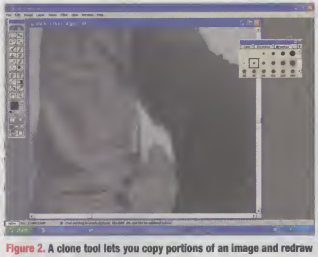


Figure 2. A clone tool lets you copy portions of an image and redraw them elsewhere to replace missing sections.

Figure 3. The large hole beneath the woman's left arm in the sample photo was completely restored using the clone tool.

If you are restoring a fairly narrow area, such as a scratch, the task may be as easy as defining a point next to the end of the scratch, clicking the edge of the scratch and moving the mouse as you paint over the scratch from one end to the other. If you are having problems replicating an area of light or shadow, paint over the area with a solid tone first and then go back over it with a lighter or darker tone, changing the opacity of the brush before you do so.

The details. Let's assume you are restoring the missing area located beneath the woman's right arm in Figure 1. In the example, the missing portion of the dress was restored by cloning the pixels above and below it. Then, the general area of the missing sleeve was restored (Figure 2) with surrounding pixels by using a small, feathered brush, (note the Brush palette in the top right). Next, more detail in the sleeve was restored by cloning some of the creases from other parts of the sleeve using a small, feathered brush with the opacity set to 70%. Finally, a large, feathered brush was used to clone the background and fill in the missing areas. The final result is shown in Figure 3.

Don't become discouraged if it takes you awhile to get the hang of cloning. You will gain better control of the process with every step. Save often and change the file name frequently so you can revert (return to a previously stored state) if desired. Once the changes are completed to a section, save the file again. There is nothing worse than losing 30 minutes of painstaking work because you have a power surge.

A Multilayered Cake. If the area you are trying to replace is highly detailed, or if you are uncertain how you will recreate the missing portion, you should perform the restorative work on a new layer. In the previous example, the area of missing pixels under the woman's arm was simple to clone, so we

To re-create the other missing areas in this image, you would also use the cloning and layer-and-copy techniques.

restored it directly onto the original layer. The large missing area on the left side of the picture, however, where it was difficult to tell what had been there originally, presented a much greater challenge.

By looking at the other side of the woman's dress, we were able to make assumptions about the design of the missing area, even though the uneven lighting made the details look different. It was apparent that a simple clone of the areas above and below the missing section would not completely restore the appearance of the dress. (An initial, failed attempt at cloning the area is shown in Figure 4.) We could not clone the right side of the dress onto the missing section, either, because the right and left sides are reversed (mirror images of one another).

■ **A Purrfect Copycat.** The only solution to restore the missing section of dress is to copy the right side, flip it over (mirror image), and rotate it so that the decoration on the copied portion abuts the decoration that remains above and below the missing areas. To copy the dress (or any other area on your own photograph), choose the **marquee tool** (a box with dotted edges) and draw a box around a portion of the other side of the dress that most probably mirrors the missing section. Copy the selection onto a new layer (press CTRL-J).

A new layer (Layer 1) will be selected (highlighted in blue) on the Layers palette. If the Layers palette is not open, click the Window menu and choose Show Layers. Click the move tool (to the right of the marquee tool). Click the area you just copied (it will no longer be surrounded by dotted lines) and drag the copied portion over so that it is on top of the missing area. Reduce the opacity of Layer 1 to 80% so you can see both the Background and Layer 1. From the Edit menu, choose Transform and Flip Horizontal to flip the new section over into its mirror image. Choose Transform, select Rotate, and click a corner of the box with your mouse. Drag it clockwise or counterclockwise to rotate the new section into place. Zoom in (CTRL-+) and perform further adjustments if necessary until the new selection most closely aligns with the existing information at the point where the hole begins on the background image (Figure 5).

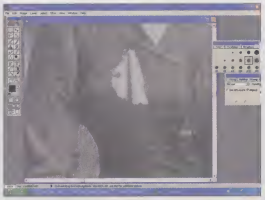


Figure 4. Because of the complexity and detail of the missing portions of the woman's dress in our example, simply cloning the area surrounding the missing information was not sufficient to restore the pixels.

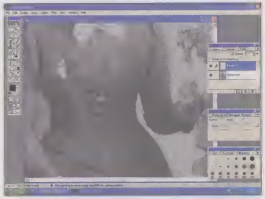


Figure 5. Copying a similar area in a photograph and then adjusting it to fit is often the easiest way to reproduce a large section where detailed information is missing.

Figure 6. We restored the missing section of the dress in the example photo by first copying and positioning a similar section into the missing section and then filling in the remaining information with the clone tool.

Select the Magic Wand tool, which looks like a microphone. On the Layers palette, click the background layer to select it. On the image, click the section that is missing, and it will be automatically selected by the Magic Wand. Choose Modify and Expand from the Select menu and enter a value of 5. This expands the selection by 3 pixels in all directions. Now, click Layer 1 on the Layers palette to select it (your selection now moves from the background to Layer 1) and choose Inverse from the Select menu in order to reverse the selection. This then selects everything but the area that was previously selected.

Choose Feather from the Select menu and enter a value of 3. Press DELETE, and all of the new selection other than the portion covering the hole on the background will be deleted. The expanded pixels will feather to transparent, letting the original image take over. Adjust the opacity of Layer 1 until the new pixels match those of the original dress. The final result is shown in Figure 6.

To re-create the other missing areas in this image, you would also use the cloning and layer-and-copy techniques. The missing areas around the edges and on the face and hair (with the exception of the eye) would be replaced using the cloning tool. The bits of trash evident throughout the image would be replaced in similar fashion. To rebuild her right eye, we copied her left eye onto another layer and moved and rotated it to form the basis of the missing eye. We then cloned the area around the eye to blend it all together. The final restored image is shown in Figure 7.

After your image has been restored, save the file in its multilayered format in case you want to edit the individual layers later. Merge the layers by choosing either

Figure 7. The fully restored image now shows no trace of its previous damage.

Merge Layers or Flatten Image from the Layers palette and save the merged file with a new name. If desired, crop the image and increase the contrast or brightness using one of the many exposure adjustment tools found under the Adjust option on the Image menu.

■ **Move Over, Ted Turner.** For many photography aficionados, the most compelling antique photos are those that have been colorized. Also known as hand-coloring or hand-tinting, this process adds a watercolor-wash effect to either the entire image or portions thereof.

Colorizing is time-consuming, but the results can be stunning, and the task is fun if you enjoy painting. Some purists prefer to add a sepia tone (Figure 8) instead of colorizing. This is an easier effect to accomplish. Once you convert an image to RGB (select Mode on the Image menu), choose the Variations option from the Adjust menu and select the tone you want.

When you colorize, the underlying gray-toned photograph becomes the basis for the highlights and shadows in your final product. New layers are added—one for each color you want to apply and each area you want to color.

It's important to keep the colors and areas on separate layers because you will be altering the opacity of each layer to adjust the color. If there are two areas that you know will have the same colorization, such as the woman's hands in this image, perform all that work on one layer.

To colorize an image, first convert it to RGB. Create a new layer by selecting New Layer from the Layers palette. From the Brushes palette, click the Color tab. Create your first color by entering values in the R, G, and B boxes or adjusting the slider bars. The color should be a darker version of the color you want, peach, for example, if you want a flesh tone. Play with the combinations until you find a suitable color.

Click the Brushes tab and select a feathered-edge brush. Carefully outline the area to be colored, then fill it in with color, making it as dark as possible. Don't worry about

Figure 8. Adding a sepia effect to an image is easy to accomplish from a black-and-white photograph and adds an attractive vintage touch.

getting the outline perfect: The feathered edge will minimize the overspray, and you can always edit the layer later. Once the color has been applied, reduce the opacity of the layer to obtain the desired effect.

Colorize and determine the opacity for each colorized section before you move on to the next selection. When all the layers have been added, adjust the opacities of any layers if necessary. You can also adjust the tone of a certain layer by selecting it and using the Variations feature. Once you are satisfied with the colorization of your selections, save the multi-layered image and then merge

Figure 9. Colorizing a vintage photograph gives it an interesting and artistic appearance.

the layers, saving the image again with a different name.

For the sample image, a peach color was chosen for the flesh tones and a deep rose color for the lips. The hair and eyes were colored dark brown, while the dress was colored purple. The background was colored green to enhance the natural look of the vines and greenery in the foreground of the image. Finally, the flowers that are in the woman's hand and the woman's lips were overpainted with flesh tones to subtly alter their hues. The opacities chosen were 60% (hair and eyes); 30% (face and hands); 40% (dress) and 20% background. The final result appears in Figure 9.

■ **A Lasting Keepsake.** Restoring old photographs (and colorizing them if desired) not only enables you to create a beautiful memento now, but also it preserves the image for future generations and helps you master the delicate art of image editing. After the restoration process is complete, your photograph will be safely stored in a digital file (be sure to make several backup copies), and your finished masterpiece will be ready for you to print to a desktop printer, share online, or send out for professional reproduction. LS

by Jennifer Farwell

Arresting Artwork

Create A Photo Collage

A picture is worth a thousand words, but some pictures literally aren't worth the paper they are printed on. A whole roll of pictures taken on Christmas morning might yield just a handful of keepers, and they end up in a kitchen drawer along with the best pictures from your Halloween party and a few from last summer's Fourth of July picnic. A more effective way to store and display your favorite shots is in the form of a collage, a visually appealing collection of several related photos arranged into a single, larger image.

In this article, we will demonstrate how to combine a group of pictures into a collage you can print for framing or use as wallpaper on a PC's monitor. With a little practice, you can learn to create a personal gallery that reminds you of good times and good friends each time you use your computer.

■ **Prerequisites.** To create our collage, we need a photo-editing program, such as Jasc's Paint Shop Pro (http://www.jasc.com) or Adobe's Photoshop (http://www.adobe.com). PSP is available for $99 as a download from the Jasc Web site; Photoshop retails for $609 and is geared more toward professionals. We used PSP to create our collage, but the process should translate easily to Photoshop or almost any other photo-editing program.

Don't forget the pictures. Along with the software, you also need the images that will become the finished collage. These images can be files taken directly from a digital camera or ones created by inputting prints with a scanner.

For the collage shown in our example, we chose five pictures from a trip to the Cayman Islands. The center image and the shot of the moray eel in the lower-left corner were taken with an Olympus digital camera enclosed in a special underwater housing. The other three images were taken with a 35mm Nikonos underwater film camera equipped with a macro lens. We then scanned the developed photographs using a Hewlett-Packard 6300c flatbed scanner at a resolution of 600ppi (pixels per inch).

When scanning photographs, it is important to select the proper resolution. For images that will be displayed on a monitor, scan at 200ppi. If you plan to create color prints using a photo-style printer, set your scanner to 300 or 600ppi.

■ **Plan First For Better Results Later.** Before diving into the collage, it is best to take a few minutes to plan the project. Select the images based on compatible subject matter and color schemes. Don't worry too much about the relative sizes of the images because you can adjust the size, and even the shape, of each image with the editing software.

The five images we chose for our collage were selected for a number of reasons. The image of the stingray and diver represents the highlight of the trip (at least for the diver), so we positioned it in the center and cropped it to be larger than the other images. We chose the moray eel just because it is an unfamiliar creature. The flower coral (top left) and "purple stuff" (bottom right) were chosen because they demonstrate the wide variety of underwater life and were positioned opposite each other because they have complementary colors. The image of the French angelfish was chosen for its 3D effect.

Once you select the images for your collage, create a new folder and copy each image into it. This will make the work that follows much easier because all the components of the collage will be in a single location.

■ **Prepare The Canvas.** To start your collage, launch PSP, click File, and click New. A pop-up window will require you to specify the initial size of your new image. Think of this blank image as the background surface on which you will assemble your collage. If you plan to print and frame your collage, you can arrange your images in portrait (taller than it is wide) or landscape (wider than it is tall) orientation. Some standard frame sizes, in inches, are 4 x 6, 6 x 8, 8 x 10, 9 x 12, and 11 x 14.

For best printing results, the resolution should be set to 300dpi (dots per inch) or higher to match the resolution of the printer. Bear in mind that the resolution directly affects the size of the final collage file. A 4- x 6-inch photo at 200dpi would contain 960,000 dots whereas the same photo at 300dpi would contain more than 2 million dots.

If you plan to create a wallpaper image, you should enter the initial dimensions, in pixels, that match your monitor's resolution. Common values are 640 x 480, 800 x 600, and 1,024 x 768. Because most monitors only support 96ppi, select 96 as the resolution and choose a background color that will complement the colors in your images. For the collage in our example, we chose 800 x 600 pixels and a resolution of 96ppi. We selected a black background color to contrast with the lighter colors in most of the images.

■ **Add The Subject Matter.** To add the first image to your collage, click File and Open. Using the Look In drop-down list, select the project folder you copied your images to and then select one of the images. Click the Open button. The image will open in a new window on top of your collage background.

Made to fit. Resize (reduce) or crop the image to fit the area of the collage where you will position it. To resize an image, click the Image menu and then Resize.

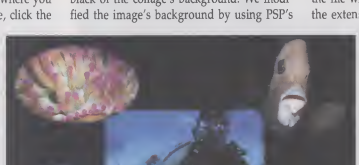
PSP offers three resizing options: Pixel Size, Percentage of Original, and Actual/Print Size. If you defined your original canvas in pixels, choose Pixel Size. If you created your canvas in inches, choose Actual/Print Size. After you enter the desired height (or width) and click OK, PSP will recalculate the color of each pixel using one of several mathematical algorithms. You'll obtain best results by leaving the Resize Type drop-down menu set to Smart size. This requests that PSP select the best algorithm based on the content of the image. Because our collage was destined to be wallpaper, we resized the four outer images to 200 pixels high; the center image was resized to 250 pixels high.

To avoid distorting the image, leave the Maintain Aspect Ratio box checked and let the editing program determine the correct width automatically. Click OK to resize the image. If you use the Resize tool to make an image larger, you will reduce the resolution and this may have a negative impact on the final quality of the image.

To crop an image, select the Crop tool and drag the cursor around the area you wish to keep. Click the Image menu and then Crop to discard everything outside the box. You may choose to use a combination of cropping and resizing. If you do, crop first and then resize what is left to be approximately 200 pixels high.

Get into shape. To create shaped images, such as the oval and round images in our example, click the Selection tool (the rectangular dotted box) and then click the Tool Options button on the Standard toolbar. In the Tool Options window's drop-down list, select the shape you would like to use in the Selection Type box and set the Feather option to a value between 5 and 10. The Feather option creates a slightly blurred edge and eliminates the normal sharp contrast edge. Place the crosshairs on the image and drag the shape outline until it covers the portion of the image you wish to keep. We chose the shapes used in our example to provide some variety to the finished collage and to crop out unwanted backgrounds.

The original background around the French angelfish was dark, but not the true black of the collage's background. We modified the image's background by using PSP's Brush tool and painting out most of the background. The result is a fish that appears to be a cut-out rather than just another image pasted onto our collage background.



This shows an example collage that we created with Paint Shop Pro. The 800- x 600-pixel image has a resolution of 96ppi (pixels per inch).

Put it together. When you have the image the way you want it, click the Edit menu and Copy to put the image on the clipboard.

Return to your collage template, click Edit, point to Paste, and click As New Layer to overlay your first image onto the template. If you place each image in a separate layer, you can rearrange them, independent of each other, after they are all pasted onto the template.

Repeat the above process for each image you wish to incorporate into your collage.

A word or two. You can add text to your collage with the Text tool. Select the tool and click the background approximately where you want the text positioned. When the Text Entry window opens, type your title in the large Enter Text Here box located near the middle of the window. You can also select the font, type size, and type color from this window. At the bottom of the window, select Floating and check the Antialias box to produce a text object that you can move with the mouse once you return to the canvas. Click OK to return to the collage. Your message will be floating over the background. Position the text exactly where you want it and right-click to paste it in place.

■ **Save Your Work.** Be sure to save your collage in the editing software's native format to preserve the layers. For PSP, you would save the file with a .PSP extension; for Photoshop, the extension would be .PSD. You will also want to save a copy of your finished work as a JPEG (Joint Photographic Experts Group) file for use as the wallpaper. Although PSP supports 44 different file formats, JPEG is the best all-around choice because it can also be used on Web pages and it is one of the most compact formats for color images. Saving the image as a BMP (bit-mapped) file, for example, will result in a file about 25 times larger than the same image saved in the JPEG format. Click File, click Save As, and select the JPEG option. When you create the JPEG file, the editing software will flatten the layers and create a much smaller file, but this also removes the capability to rearrange the images later. If you need to make changes to your collage, reopen the native file, adjust the images, resave in the native format, and then re-create the JPEG file.

To install your wallpaper masterpiece, right-click your Desktop and click Properties. When the Display Properties window opens, click the Desktop tab and then the Browse button. Locate your saved JPEG file, select it, and click the Open button. Click Apply and OK to configure your Desktop to use the new collage image as its wallpaper.

■ **Go Forth & Create.** The simple vacation example above should give you some ideas for collages of your own. Pictures of friends or family also make great collections and add a personal touch to your PC. If you have access to a photo-quality printer, such as the Epson Stylus Photo 890 or the Hewlett-Packard Photosmart 1315, you can easily turn your collage into a high-quality print suitable for framing. Add an inexpensive frame and you have a unique Christmas or birthday gift for that special friend who has everything. LS

by Dick Archer

Digital Photos Demystified

Down & Dirty Details To Print Better Photos

You have always envied the geeky-looking guy at the Wal-Mart photo lab because he gets to wear that cool blue vest and happy-face nametag. Thanks to the digital photo printing revolution, you can one-up your photo-lab hero by capturing—and printing—photos without even leaving your house.

In this article, we'll help familiarize you with a few fundamental digital camera and printing concepts. We might also give you a fashion pointer or two; namely, that blue vest really isn't all that cool, especially when you're wearing it alone in your living room.

■ **Resolution Details.** Before you can print a digital photo, you need to buy a digicam to help you capture an image, and when shopping for a digicam, you'll need to have a basic understanding of resolution. **Resolution** refers to the clarity of an image, and it can be as confusing as it is critical, thanks to a plethora of Web sites that over-complicate or oversimplify resolution concepts. We'll clear things up by quickly explaining how your camera's resolution affects your final printouts.

Camera resolution. Most digicams are equipped with a **CCD** (**charge-coupled device**), which is a sensor behind the lens. The CCD is divided up into a grid of many tiny **photosites**, the light-sensitive components of the CCD that record images as **pixels** (picture elements).

Pixels are the smallest components of an image a computer monitor or printer produces. Cameras with higher resolution ratings use more pixels to create an image.

If the concept of pixels confuses you, think of a painting technique called pointillism. Instead of broad brush strokes, pointillists painted using only tiny, single-colored dots on the canvas. Up close, you can see the individual dots. From a distance, the individual dots are nearly impossible to see because they blend together to form a larger image. The same technique applies to pixels in a digital image.

Numbers indicate the resolution of the CCD in each digital camera. For example, 640 x 480 is a number combination that is used to designate the lowest-resolution setting in many cameras. The number 640 represents horizontal pixels and 480 stands for vertical pixels. Multiply the numbers and they equal 307,200, which is the total number of pixels your camera uses to capture images.

If you multiply the resolution dimensions of your camera's CCD and the resulting number is 1 million, the camera has **megapixel** capability. Most cameras costing more than $150 have at least 1-megapixel resolution.

Print resolution. The number of pixels that your camera uses to capture images is critical when the time comes to print a hard copy. Your printer needs lots of data from your camera to create photos with striking details and good colors. So, the higher your camera's resolution, the better your photos will look.

Let's assume that you take a photo using your camera's 640 x 480 resolution setting. That gives your printer a total of 307,200 pixels with which to produce a photo—enough pixel data to create a 2- x 3-inch print of average quality.

But if you want to print an 8- x 10-inch photo, your printer still has only 307,200 pixels at its disposal. As a result, the pixel data is spread more thinly, the pixels get bigger in a futile attempt to fill in empty space, and the image's details quickly become blurry.

You can estimate the maximum printable size of any image you capture by approximating its ppi (pixels per inch) rating. This rating basically indicates pixel density and helps you to estimate whether or not your image has enough resolution for the print size you desire. Keep in mind that, in general, quality printed photos have a rating of between 300 and 600ppi.

To estimate an image's ppi rating, divide the camera resolution by the dimensions of the photo you want to print (640 / 2 inches = 320ppi; 480 / 3 inches = 160ppi) and take the average of the two ppi ratings (240ppi). In other words, our 2 x 3 will look fine at its original size on a 72ppi monitor, but it may not be as sharp as we'd like for a high-quality print.

This formula isn't perfect though, according to Parker Plaisted, a photo imaging product manager at Epson. He says that a 300 to 600ppi rating generally provides good photos, but that "These numbers are based on human vision, not the printer resolution." Plaisted says this is because printer and image resolution aren't directly related due to the fact that printer resolution is higher than the resolution perception of the human eye.

That said, use our formula only as a general guideline, and let your eyes tell you which ppi rating looks best. One thing's for sure: If you want to print a photo bigger than 2- x 3-inches, you'll have to capture an image

Your camera compresses images *for the same reason a garbage truck has a large compacting device:* to save space.

using a resolution setting higher than 640 x 480 on your camera. A higher resolution setting gives your printer more pixels with which to construct a clear, colorful image.

The ppi rating applies to on-screen image resolution, not print resolution. Instead, printers, such as an inkjet, use a dpi (dots per inch) rating, and here's the simple reason why: Inkjets spray tiny droplets of ink, often using multiple droplets to reproduce just one pixel. Imagine isolating one green pixel of your favorite image. When your printer prepares to print this pixel, it knows it must spray a combination of multiple yellow and cyan dots to create that single pixel. Because many droplets may be fired to create just one pixel, the number expressing dpi rating may be a higher number, such as 720dpi, as compared to the 300ppi rating of an on-screen image.

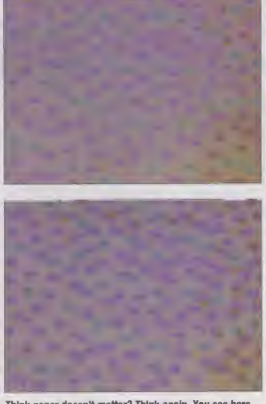
So to print the best quality photos, you should pump up your printer's resolution to the maximum setting, right? Not necessarily, but we'll cover that topic later in our tips section. Let's address a few more digital camera topics first.

■ **Digicam Elements.** You understand that your digicam's resolution setting will ultimately limit the size of the photos you can print, but that's not the only factor that affects the quality of your photos. Many cameras also let you adjust the level of compression used to store the photos in the camera.

Your camera compresses images for the same reason a garbage truck has a large compacting device: to save space. A camera doesn't smoosh empty milk cartons, obviously, but it does use a couple of different techniques to make your images smaller and, thus, free up more memory space for subsequent pictures.

Most digital cameras store photos as JPEG (Joint Photographic Experts Group) files. JPEG files use a **lossy compression** technique, which means that some of the image data is removed to make the final file smaller. That makes the image easier to store and transfer, but it also means the file suffers quality degradation.

The good news is that many cameras offer varying degrees of compression, often designated by terms such as Superfine, Fine, and Normal; these settings give you control over photo quality. Using a setting such as Superfine compression reduces data loss and makes for more printable photos, while a setting such as Normal deletes much more image data to make the final file smaller.



Think paper doesn't matter? Think again. You see here that ink droplets react very differently depending on the paper you use. A paper with a good coating, such as the one on the top, helps a printer create better-formed dots than a less expensive uncoated paper.

Photos courtesy ImageXpert

Some cameras let you save photos using file formats other than JPEG. The most common alternative is TIFF (Tagged Image File Format). TIFF is an uncompressed (or **lossless**) file format that saves images without data loss, making them perfect for printing. The problem with TIFF files is that they devour a lot of memory. Depending on your camera, TIFF files may be many megabytes to a few gigabytes in size.

There are also other file formats in use by specific camera companies. For example, a few Canon digicams use a proprietary file format called RAW. RAW images are similar to TIFF files, in that they don't discard image data. However, RAW files require less memory than TIFF files and are only a little a larger than a low-compression JPEG.

Now you have a better understanding of resolution and the image file types that will help you capture printable photos. Next, you need to know what type of printer best suits your printing needs.

■ **Printer Technologies** After you snap the perfect shot with your digital camera, you can use your printer to create a hard copy. A number of printer technologies are available for color printing, and each has a number of strengths and weaknesses for photo printing.

Laser printers. Color laser printers are expensive and typically limited to office settings. If you have access to one, you might have considered trying to print a few photos. We wouldn't recommend this because although lasers are great for printing a few clip-art graphics and lots of text, they aren't great photo makers.

Most lasers scar photos with a lot of **banding** (wavy lines) that distort images. Printers that don't cause banding add very little color depth to photos, resulting in prints that look flat and uninspiring. Worse yet, lasers often take longer to print photos than printers costing 1/10 of a laser's price, and lasers don't use the glossy photo paper that gives great photos a professional feel.

Dye sublimation. Compared to lasers, dye sublimation (or dye sub) printers are a far superior choice for photo printing. Each dye sub printer uses a heat-sensitive ribbon cartridge containing three colors of dye. The printer warms this ribbon and **sublimates** (converts directly from a solid to a gas) the dye so it affixes to the specially coated glossy paper. Variations in heat affect the

Does My Image Have Enough Pixels Per Inch?

Here's a quick way to estimate a photo's ppi (pixels per inch) rating. For this example, assume the camera resolution setting is 1,600 x 1,200 and you want to make a 4- x 5-inch print. Remember that good quality prints usually have a ppi rating between 300 and 600ppi and that these are estimated numbers. They'll simply give you a rule of thumb to determine the pixel density of an image.

1,600 / 4 inches = 400
1,200 / 5 inches = 240
400 ÷ 240 = 640
640 / 2 = 320ppi

Note how the ppi rating changes according to the image's size.

Camera resolution set to 1,600 x 1,200
Estimated resolution:
2- x 3-inch print = 600ppi
5- x 7-inch print = 245ppi
8- x 10-inch print = 160ppi

intensity of each color and allow for precisely shaded images.

Although lasers printers use dots to create images, dye sub printers transfer the exact pixels your camera captures. This means your photos look extremely realistic, especially when compared to the output of a laser.

Though dye sub printers are superior photo printers, they have a number of shortcomings, starting with their weighty price tags. Olympus' P-400 (http://www.olympusamerica.com), for example, prints full-page photos but sells for nearly $1,000.

There are plenty of other options, such as the $279 DPP-MP1 from Sony (http://www.sonystyle.com) or the $299 CP-10. These printers are small enough to tote in a backpack, but they output only wallet-sized photos. Cheaper alternatives are available from SiPix (http://www.sipix.com), which sells printers such as the $99 PocketColor 100, but bear in mind that cheaper printers create cheaper-looking photos. If you're looking for portability, these inexpensive printers are great, but if you want standard-sized photos, you'll have to look elsewhere.

Another drawback to dye sub printers is the expensive consumables they require. Paper and color cartridges are usually sold together in combo packs that let you print about 20 photos. In most cases, the final printing cost will be at least 80 cents or more per photo. Finally, dye sub printers tend to have sluggish printing speeds; even tiny pocket-sized photos require about a 2-minute print cycle.

Inkjets. When it comes to photo printing, nothing beats an inkjet. Inkjets work by shooting thousands of tiny droplets through the nozzles of a print head and onto a sheet of paper. Most printers use the CMYK (cyan, magenta, yellow, and black) method of printing. Combined in varying amounts, these four hues let inkjets reproduce millions of colors.

One of the primary benefits of inkjets is that they cost much less than laser or dye sub technology. Canon, HP, Epson, and Lexmark all sell inkjets that cost less than $100.

However, consumables expenses are sometimes high for inkjets. First, you'll have to consider the cost of paper. The best inkjet papers cost $1 per page or more. Second, when your printer's ink cartridges run dry, you'll have to replace them, and such cartridges can cost upward of $30 apiece. This can get expensive in a hurry, especially for six-color photo printers that use light cyan and light magenta ink in addition to the typical CMYK inks, such as Epson's (http://www.epson.com) Stylus Photo 780.

Canon's S520 spits out full-page photos in less than three minutes. It also deftly dispenses simple graphics and text.

Most cartridges, before they're emptied, will let you print at least several dozen full-page photos, and because black is often used for text in addition to photos, it's sold in larger, more economical tanks. You can also save money on paper by using excellent matte finish paper that costs less than half the price of the glossy stuff.

Besides their potential cost savings, inkjets have another big strength: speed. Compared to laser and dye sub printers, inkjets are blazing fast. Canon has built a reputation for quick printers. Its S820, for example, can crank out a full-page photo in less than three minutes.

Inkjets are undoubtedly the most economical and efficient way to print photos at home. The problem now, of course, is deciding which printer to buy.

■ **Top Inkjets.** Before you go inkjet shopping, prioritize. First, decide if you want a printer just for photos or if you need an inkjet that will double as a good text printer. Then consider the importance of speed and final photo quality. Once you've ranked the importance of these characteristics, you'll be prepared to buy.

If you want a speedy printer, Canon (http://www.usa.canon.com) makes some of the fastest photo printers on the market. This company's S-line printers consistently beat other printers in our speed tests, and they're suitable for text printing. Hewlett-Packard (http://www.hp.com) also makes a number of great inkjets, such as the Deskjet 940c, that balance text and graphics performance.

If your No. 1 priority is printing the best possible photos, Epson's Stylus Photo models have an excellent reputation. These six-color printers create photos that put some printers to shame and yield richer hues, much smoother color transitions, and clearer details. Epson offers printers for smaller budgets, such as the six-color Stylus Photo 820, which sells for $99. The company also sells a revolutionary seven-color printer, the $699 Stylus Photo 2200, which includes a light-black ink to create better black-and-white prints.

Picking out the right printer can be a tough decision, especially if your savings account is depleted because of your digicam purchase. Remember that no matter which printer you pick, you'll

Different print heads require differently formulated inks to produce precisely placed droplets.

still have to put thought into the consumables you buy.

■ **Printer Consumables.** Shoes and socks, influenza and NyQuil, sparks and gasoline fumes—although some things just go together, others are definitely not such a good idea. Keep that in mind when you go shopping for paper and ink cartridges. Choosing the right consumables can mean the difference between photos you'll want to frame and photos you'd like to see go up in flames.

Inks. Picking the right ink and paper combination is important partly because each inkjet manufacturer uses different print heads to spray ink onto a page. Hewlett-Packard, Canon, and Lexmark use a print head that warms the ink, while Epson uses a print head that mechanically "pumps" ink onto the page.

Different print heads require differently formulated inks to produce precisely placed droplets. Every ink type differs in viscosity, pH balance, and other intricate traits. Manufacturers also experiment with a wide range of base ingredients in their inkjet, from oil-based dyes to resin-encapsulated pigments.

Because of these complexities, ink can be expensive, and when you go shopping for replacement ink cartridges, it's easy to get sidetracked by products promising to save you money. Cartridge refill kits are available in many retail outlets, and the Web is burgeoning with sites, such as Universal Inkjet Refill System (http://kalvins.com), that sell refill kits or remanufactured cartridges containing third-party inks.

We've tested refill kits and found them to be somewhat messy and hard to use. Thus, we don't recommend them, especially to novice users who don't need the added hassle of using such kits when they're settling in with a new printer.

More advanced users may save money when printing a lot of text, but third-party color inks aren't ideal for photos. The biggest concern about color inks is longevity. Companies regularly test the photos their printers create by exposing the photos to extreme lighting conditions. When the tests are completed, the companies assign approximate lightfastness ratings to the inks. Prints from Canon's S820, for example, should last about 25 years before noticeable fading begins.

Third-party inks, however, aren't subjected to such rigorous testing. For photographers concerned about archival properties in their prints, the worry about premature fading isn't worth the desire to save a few bucks on ink.

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INKJET REFILL SYSTEM
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About Computer Business Works, Inc.
Computer Business Works began distribution in 1995 and as with most other web based marketers has
seen phenomenal growth. Currently our sales have reach the Africans continent to Australia. Since starting
in the United States our sales have grown exponentially.

Inkjet refill kits may help you save money, but third-party inks may not last as long as the inks your printer's manufacturer recommends.

Papers. Because inks have such exacting specifications, they'll work properly only with certain papers. Take Hewlett-Packard's finest glossy paper and feed it into an Epson, and the resulting print will make you think your printer has gone haywire. The same rule applies to ink/paper combinations throughout the industry. Mixing brands simply doesn't help you create optimum quality photos.

There are third-party papers developed for specific printers. Web sites such as InkJetArt (http://www.inkjetart.com) and Pictorico (http://www.pictorico.com) can help find papers that work great with photo printers.

Now that you understand the role ink and paper play in creating good photos, read on for a few more tips that will help you print photos more quickly.

■ **Printing Pointers.** Earlier in this article, we discussed the role of resolution in creating good photos. You'll recall that although the pixels in an on-screen image are measured with a ppi rating, inkjet resolution is rated by dpi. You also know that an inkjet can spray multiple droplets to re-create just a single pixel from the on-screen image, which is why numbers representing dpi resolutions are often so much higher than the image resolution.

But do you really need to crank your printer to its highest resolution setting to create the best possible photos? The answer is no. As with so many other products, inkjet manufacturers include high-resolution ratings on the box for marketing purposes.

The next time you print two copies of the same photo, print one at the highest possible resolution in your printer driver and print the other at your printer's default setting.

When you select Print from the File menu of the application you're printing in, you'll see the Print dialog box. Click Setup, click Properties, and look for an option that lets you alter print quality. Typically this option is indicated by terms such as Best, Normal, and Fast, where the Best setting is the highest dpi setting and Normal is the default setting.

In most cases, you won't see a noticeable difference, and the default setting will print much more quickly, too. As a result, you'll print photos much more quickly in the future.

■ **Parting Shot.** Developing your own digital photography setup can be a rewarding experience, even if you don't get to wear a nice vest like the guys at Wal-Mart. The equipment involved does have its quirks, and fine-tuning resolution and paper-and-ink combinations takes perseverance. After a little practice, though, you'll be printing photos like a blue-vested pro. LS

by Nathan Chandler

For Generations To Come

How to Archive Your Digital Photos

Shoeboxes are terrible places to store old photographs, but despite their nearly absolute lack of organization, they do have two true benefits: The pictures are still here, and you can still recognize what is on the paper. Daguerreotype photographs from almost 150 years ago may be faded, but the ones that have been properly cared for are still in great shape.

Digital media is a double-edged proposition. On one hand, digital images are vastly more portable and far easier to edit. On the other, although analog images are as permanent as the paper they're printed on, digital images are subject to the ravages of shifting software platforms, degrading storage media, and companies going out of business.

There is no question that digital photography is replacing film photography. Your object is both to capture and preserve images so your grandchildren will still be able to view your creative labors in a form that is as good as or better than how you first saved them.

■ **File Formats.** Digital images can become obsolete and unviewable even if the platform never changes, and if the image is unviewable, the image is as good as destroyed. Most often, this danger crops up when you use nonstandard file formats or formats that any particular company owns.

"If you're picking a file format, pick something standard, particularly JPEG (Joint Photographic Experts Group) or TIFF (Tagged Image File Format)," says Rajiv Mehta, director of digital imaging at Adobe Systems. "Don't pick something esoteric. I have friends who created major works in the LivePix format, and now they can no longer get to any of it, so all their work is gone."

Nearly all digital cameras capture in either JPEG or TIFF, but the distinction between them is important. For more on these technologies, see "File Formats" on page 111. If you don't have enough flash media memory to shoot in TIFF format, we recommend shooting in low-compression JPEG mode, transferring the images to your PC, then converting the shots you want to keep into TIFF format with a photo editor. This "freezes" the image into a lossless, industry standard format that should preserve well for many years to come.

■ **The Danger Of Albums.** Even if you're assiduous in weeding out everything except your best images, it doesn't take long before you have hundreds and possibly even thousands of images populating your hard drive. This is worse than throwing everything into a shoebox because now each image has to be opened in some kind of viewing or editing application in order for you to get a good look at it. (Note that the Filmstrip view in Windows XP does a decent job of giving previews, but not at full-screen dimensions and the application can take a long time to load thumbnails.) Many cameras will save images with incomprehensible names, such as PBC0100832. It falls to you to apply some organization to this chaos so you can find images when you want them.

Start with the file name. Once you transfer the images to your PC, pick the ones you plan to keep and give them file names that include both the subject matter and date, such as "Aunt Mabel at family picnic—July 2002." In effect, this is the same as the writing traditionally done on the back of snapshots. The real advantage of names such as this is that not only do they give the image's essential information, but you can now use your PC's Search/Find function to scan for files containing keywords from the title.

By default, Windows sticks all of your photos into the My Pictures folder. We recommend creating more descriptive subfolders in My Pictures, such as Aunt Mabel or Family Picnic. Your goal is to keep images as intuitively organized as possible.

Naming files and folders is effective, but as you amass scores of folders and thousands of images, even this system becomes cumbersome. What you want is a powerful organization application: a digital asset management tool. ThumbsPlus from Cerious Software ($79.95; http://www.cerious.com) is a long-standing favorite of trialware users thanks to the company's generous evaluation program. ThumbsPlus lets users create customized databases that showcase specific images, build slideshows, apply keywords and annotations to images, and search throughout the system for images.

Best of all, ThumbsPlus supports batch conversion of images from one file format to another. Say you have several images still in JPEG format you want to archive. ThumbsPlus lets you select all of these JPEGs and save them with the same file names, but in TIFF format, to the location of your choice. This one function alone is worth the application's $80 price tag to prolific photographers.

Another popular digital asset management tool is Extensis' Portfolio ($199.95; http://www.extensis.com). Portfolio uses a feature called FotoSync to track images. For example, if you originally create a catalog with an image located on the C: drive and move that image to the D: drive, your Portfolio catalog will automatically note the location change so the catalog's contents stay viewable, a critical tool for keeping your photo archives organized.

Perhaps even more important is the Collect & Publish tool, which not only helps you export catalogs to disc-based archives but also keeps

track of which disc any given image is on. When you later query for the photo, Portfolio tells you which archive disc to retrieve. Volume archivers will have a hard time living without this tool.

The trouble with asset management tools, including all photo album applications, is that there are no industry standards behind them. If Cerious or Extensis goes out of business or their software fades from popularity, you might find yourself unable to use your image catalogs, and all of the metadata (keywords, annotations, and such) you've entered for managing your photos will be useless. This is why Adobe's Rajiv Mehta recommends keeping individual copies of your images independent of album or asset management applications. These are handy tools, but you need to make sure your photos are as liberated as possible from vendor-specific ties.

■ Where To Store Your Images. Nothing lasts forever, and hard drives are no exception. Under regular use, all hard drives will eventually fail, so don't make the mistake of trusting your valuable images to them permanently. You want to create an archive of your shots, but make sure the archive doesn't reside on your main hard disk and preferably not even in the system at all.

In January 1995, *Scientific American* published an article called "Ensuring the Longevity of Digital Documents" and detailed the following statistics for average media life expectancy (medium, time until obsolete, physical lifetime):

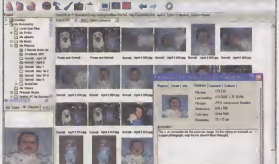
- **Magnetic tape**, 5 years, 1 year.
- **Videotape**, 5 years, 1 to 2 years.
- **Magnetic disk**, 5 years, 5 to 10 years.
- **Optical disc**, 10 years, 30 years.

As any cassette owner knows, magnetic tape stays playable for decades, but the media itself may start degrading information at the bit level after only a year. Moreover, the 250MB QIC-80 tape cartridges that were on desktops everywhere in the early '90s had all but vanished by the late '90s, and without drives to play the media, the data is dead.

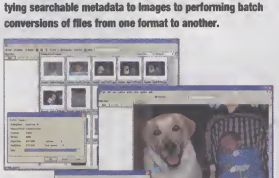
In our office, we use an external Maxtor 3000LE 40GB USB 2.0 hard drive to archive digital media, but this is only meant for short-term storage. We still have parallel-based printers and scanners that won't connect to our newer "legacy-free" PCs. It's only a matter of time until USB 2.0 and even today's IDE (Integrated Drive Electronics) internal hard drive interfaces meet a similar fate.

Clearly, recordable CD or DVD is the archiving medium of choice today. (We might counsel buyers to wait another year or so before settling into recordable DVD, just to let the format wars die down.) Burning images to CD is cheap, easy, and safe, particularly if you keep the discs in either a safe or outside facility, just in case a natural disaster destroys your home or office.

The biggest mistake you can make, though, is to burn your images to disc and forget about them. Three years from now, CD technology and the TIFF format may be on their way out. If so, you're in danger of losing your images.



ThumbsPlus gets our hearty thumbs-up. Once little more than a handy way to view folders filled with images, ThumbsPlus now offers a fleet of features ranging from tying searchable metadata to images to performing batch conversions of files from one format to another.



Not only will Extensis' Portfolio remember which disc or tape any given image is saved on, it will also track files as you move them to new locations so you will never face misplacing an image again.

■ Print Some. Paper is proven. But outputting to your home photo printer isn't good enough for archiving. Most consumer-level inks start fading after only a few years, and most printer paper contains acid that will cause the material to degrade.

Professionals and hobbyists will want to turn to a printer such as Epson's SP-2200 ($699; http://www.epson.com). This seven-color photo printer uses special archival quality ink rated for 75 years when stored under glass. Epson also notes that printed images should be stored on acid-free paper and kept in an archival sleeve for better protection.

Some manufacturers also use a photo printing process called dye sublimation, which essentially melts colored waxy material onto the page in layers. Sony makes four dye sub printers and states that, when used with the company's Supercoat 2 paper, images will last for as long as 100 years.

■ How Much is Enough? Flawless quality prints can be obtained from far smaller file sizes than ever before. According to Greg McCoy, senior product marketing manager at Epson America, images really only need to be between 240 and 280dpi at the final output size to achieve true photo quality. And if your current needs only cover 8- x 10-inch prints but you worry that 10 years from now you might want to print an 18- x 24-inch version of the same image, rest assured that future interpolation technologies will yield satisfactory results from your moderately sized file.

■ Last A Lifetime. Archiving digital photos is an exercise in common sense carried over from the analog world. Do you use a shoebox or well-labeled albums? Do you leave these albums sitting out in the damp basement or stashed in a dry, safe, but still accessible place?

In the digital world, keep your images in safe file formats at reasonably large resolutions and secure them on CDs for safekeeping. If you have a lot of images, manage them with appropriate software and perhaps print and store the best of them onto paper using archival-quality materials. Most important of all, be sure to keep your media current and copy your collection into the latest formats as necessary. Follow these few steps and you can rest assured that your family will enjoy your 21st century photographic efforts well into the 22nd. LS

by William Van Winkle

Share The Wealth

How To Post Photos To A Web Site

One of the key benefits of digital cameras is that they let you take photographs you can share with friends and loved ones via email or the Web. Best of all, you do not need to be an HTML (Hypertext Markup Language) coding wizard to set up your own online photo album.

The Web is thick with free, easy-to-use photo-sharing services, most of which provide the added option of ordering high-quality prints of your digital images. Additionally, you may opt to use the photo-sharing capabilities of Windows XP (if you happen to be running that OS [operating system]).[1] Either way, you don't ever have to touch an HTML editor or an FTP (File Transfer Protocol) client in order to share photos online.

■ **The Easier, The Better.** In the olden days of digital photography and personal Web pages (about three years ago), the best way to share your photos over the Internet was to email copies to people or manually create your own Web page by coding an HTML document to display the pictures. Although both options are still available, you thankfully do not have to rely on either to show off the latest photos of your chubby cat to friends and family.

In fact, the entire process is nearly effortless now, thanks to the proliferation of online photo labs, which are sites that let you generate standard photo prints from your digital images. The majority of these sites, including Ofoto.com (http://www.ofoto.com) and Shutterfly (http://www.shutterfly.com), offer photo print development as their primary money-making feature but provide online photo album features free to any registered user.

■ **Get Started.** To post your images on either Ofoto.com or Shutterfly.com, you first need to register on the site. Typically, registration is free (if it isn't, keep looking for a site that is) and takes just a few moments to complete.

Once you are signed up, you gain access to all of the site's features. For example, on Ofoto .com, members can create custom photo albums by uploading images from their hard drives to the Ofoto.com site without paying a cent. In fact, the FAQ information in Ofoto.com's Help section states that users can post as many images as they like so long as they are members of the site. It does go on to say that Ofoto.com is not responsible for lost images, however, so it's a good idea to back up copies of your images even after you post them on the Web.

■ **Make An Album.** Sticking with Ofoto.com as our example site, the service greets users with a screen showing any photo albums you have already created on the site, as well as a sample album. A series of tabs runs across the top of the site, each leading to a different feature or section of the site.

Click the Add Photos tab to begin a new album. You should not have to look very far on the subsequent page for guidance: A big button marked Create New Album appears in the main content area of the page. Click this button to begin your album and fill out the text fields on the following pages to identify and annotate your album. You can fill in a title for the album, a date, and a brief description, all of which help you keep things organized (especially if you plan to create several albums).

We are describing a single site's design and feature set, but you will find that most online photo sites are set up in a similar fashion. Adobe's Shutterfly.com, for example, also starts the process with a big button marked New Album and lets you fill in a title and date to identify the album.

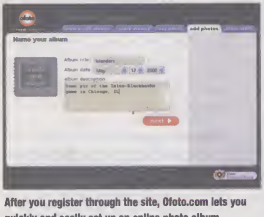
■ **Uploads, Uploads.** Once the album is created, upload images to it. On Ofoto.com, you have three uploading options, each accessed via Upload Tools. The first is to use the Browser Upload feature, which simply provides three blank fields, each accompanied by a typical Windows-style Browse button. Click the Browse button to open a file selector menu, navigate to the photo you wish to upload, highlight it, and click OK to mark it for uploading. Using the Browser Upload feature, you are limited to uploading three images at a time. Once you have your images selected, you simply click Next to begin the upload.

Drag & Drop Upload is a slick feature that lets you drag images right onto a Java applet in the Web page. Basically, you open My Computer or Windows Explorer and navigate to the folder containing your images. You then highlight the ones you want to upload and drag them right onto the Web browser window, releasing the mouse button when you have them over the Drop Photos Here button. Once you release the mouse button, the upload commences. Finally, use the Select Upload feature to launch a file selector menu from within your browser. This is very similar to the Browser Upload feature, except that it lets you select multiple files for uploading.

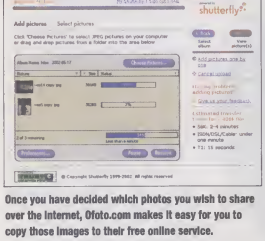
Shutterfly.com offers similar features: You can either drag and drop images onto the file upload applet or choose them through a menu. Shutterfly.com also offers a nifty upload status display so you can see how far along your uploads are progressing. The site offers an estimate of the time required for the upload, based on three common connection speeds (56Kbps [kilobits per second], DSL [Digital Subscriber Line]/Cable, and T1).

Note that by uploading images to Ofoto .com, Shutterfly.com, or any other online photo site, you are only sending a copy of your photos to the site. The original image still resides on your hard drive.

■ **Size Matters.** As with any task involving the upload or download of files over the



After you register through the site, Ofoto.com lets you quickly and easily set up an online photo album.


Digital Photo Center
powered by
shutterfly
Add pictures
Select pictures
Select album
Make print(s)(s)
Cancel upload
Edit pictures one by one
Edit all after this batch
Enhancements
Sharpen
Remove redeye
Crop
Rotate
Remove scratches
Fix color
Fix contrast
Fix lighting
Fix exposure
Fix saturation
Fix tint
Fix sepia
Fix black & white
Fix vignette
Fix borders
Fix text
Fix clipart
Fix frames
Fix textures
Fix backgrounds
Fix overlays
Fix shapes
Fix effects
Fix filters
Fix brushes
Fix patterns
Fix gradients
Fix masks
Fix layers
Fix blending
Fix opacity
Fix transparency
Fix feathering
Fix anti-aliasing
Fix smoothing
Fix sharpening
Fix blurring
Fix noise
Fix grain
Fix dust
Fix scratches
Fix dirt
Fix spots
Fix blemishes
Fix redeye
Fix whitening
Fix brightening
Fix darkening
Fix contrast
Fix color

You've Got Video

Email Video To Friends & Family

It can get very lonely serving your country abroad, but Give Thanks America (http://www.givethanksamerica.com) is doing something about that. The organization gives the loved ones of soldiers overseas the opportunity to record video greetings and send them directly, via email, to their patriots. The proliferation of cheap digital video cameras and video capture devices has spawned the desire to create and share video messages. And although the ability to produce Internet video was once limited to companies with the funds to buy sophisticated equipment, it's now available to the rest of us.

One obvious outlet for the massive amounts of new video data being produced is email. Imagine that new parents want to send video of their new baby girl to her grandparents. They can record the video on their new digital camcorder, transfer it to their computer, and email it out. This means that Grandma and Grandpa can see the movie mere minutes after it was filmed, even if they live a thousand miles away.

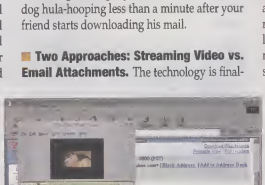
■ **Advancements In Computer Technology.** Not long ago, this scenario would have seemed impossible; even today, figuring out exactly how to send video via email is not a trivial task. You must decide between streaming video and attachments, and you must take into consideration the size of the file you're emailing. Luckily, several recent advancements in computer technology have made your job a little easier.

Increasing availability, decreasing cost. Midpriced digital camcorders now cost roughly $500. This is only slightly more expensive more than their traditional analog counterparts, and prices are still coming down. And basic **video capture devices**, which convert the signal from a standard camcorder or VCR to a digital signal your computer can understand, are currently available for from $100 to $300.

Better video technology. New and better compression standards are being developed all the time. Currently, video can be compressed by a factor of about six before the effects of compression become visible. However, some loss of quality is certainly tolerable for the purpose of, say, sending your friend a video of your dog hula-hooping. Compression ratios of 50:1 are not uncommon if you're willing to sacrifice a little quality. This means you can take a 50MB video and compress it to roughly 1MB, certainly small enough to send via email.

Higher bandwidth. Naturally, as DSL (Digital Subscriber Line), cable modem, and other high-speed Internet solutions have become more common, the transfer of large files has become more feasible. For example, any respectable high-speed Internet connection is capable of downloading a 1MB file in less than a minute. This means that if the compression is high enough, your friend can see your dog hula-hooping less than a minute after your friend starts downloading his mail.

■ **Two Approaches: Streaming Video vs. Email Attachments.** The technology is finally at the point where the transfer of video through email is plausible, but there are two fundamentally different ways in which this can be accomplished: actual email attachments and streaming video technology.



Yahoo! has a typical Web interface that lets users open video attachments.

Email attachments. The easiest way to send video is to attach it to an email. Simply use video-editing software to convert the video to the appropriate format, attach it to an email, and send it to your friend. As simple as this may seem, it's not a bad solution to the problem. Its main advantage is that it does not require the use of special streaming video servers, so you can do it with any standard email client. Also, most Web-based email services (such as Hotmail or Yahoo! Mail) make it easy to receive multimedia attachments. Typically, the email containing the attached file includes a link that says something like "Open Attachment." Clicking the link causes the video to be downloaded to your computer and displayed in a separate window. Standard email clients, such as Outlook, also do a good job of handling these files.

Despite the ease with which one can send video attachments, there are still a few things you must take into consideration before taking the plunge.

File format. Video file formats abound. Sadly, no one video player can decode all of them, so it's best to choose a common one such as QuickTime, RealVideo, Windows Media format, MPEG, or AVI; most people won't have software to handle other, more uncommon types of files. RealVideo files are small, but of lower quality than some of the other file formats. Just about every media player will play MPEGs, including QuickTime Player, Real's RealOne player, and the Windows

At left, you can see the original movie at a resolution of 720 x 480. At right, the movie was reduced to resolution of 160 x 120.

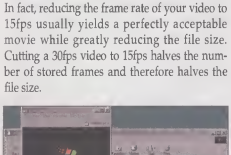
Media Player. The best all-around choice is probably MPEG, because MPEG files are relatively small and the video quality is high.

File size. Video files, regardless of format, tend to be quite large, and attaching a video file to an email raises two issues. First, many free email services provide only a very small inbox, and an emailed attachment takes up space in the user's inbox. Because the typical inbox on a free account is limited to less than 5MB, one must be careful not to send large files to someone using a free email service. If there is no way to reduce the size of the movie to less than 1MB, make sure you have the permission of the recipient before you send it. Second, there are still many people out there using dial-up Internet connections. Consider that it takes roughly five minutes to download a 1MB file with a 28.8Kbps (kilobits per second) modem. For most people, waiting any longer than that to view an attachment is just about unbearable.

■ **Reduce File Size.** If you can reduce the size of the file, then attaching a video to an email becomes a viable option. Fortunately, there are some things we can do about the size of a video. Any standard video-editing package can perform the file-reduction operations suggested below.

Decrease the image size. A 1,024 x 768 movie contains 1,024 rows and 768 columns of pixels. Reducing your video to 320 x 240 should result in video that takes up significantly less hard drive space while still preserving a reasonable degree of quality. If a movie is reduced from 1,024 x 768 to 320 x 240, the total number of pixels per frame has decreased from 786,432 to 76,800. This is a reduction by a factor of roughly 10, so the reduced file should be about one tenth the size of the original.

Decrease the frame rate. The frame rate, measured in fps (frames per second), describes how many images make up one second of footage in the video. A "normal" frame rate is about 30fps, but it's possible to cut out frames without destroying the appearance of motion. In fact, reducing the frame rate of your video to 15fps usually yields a perfectly acceptable movie while greatly reducing the file size. Cutting a 30fps video to 15fps halves the number of stored frames and therefore halves the file size.



Click on a link to streaming video to open the movie in a media player.

Decrease sound quality. Sound is typically recorded in stereo at a **sampling rate (an indication of how often the recording device measures the current sound)** of 44.1KHz, at 16 bits per sample. A large number of bits per sample results in a large file with very good sound quality. If you don't need stereo sound, setting the sound to mono will cut the size of the audio portion of the file in half. The sampling rate can also be dropped, and so can the bits per sample. This will affect the sound quality, but voices and music will still be perfectly understandable. The effect of these changes is a drastic decrease in the size of the audio track. And if your video is of a gyrating canine, sound may not even be necessary at all; just drop the audio track altogether.

■ **Streaming Video.** Using streaming video technology to send movies to email recipients is not, strictly speaking, the same as sending video via email. Instead, what you send is a *link* to the video; the video itself is stored on a server somewhere on the Internet. The recipient clicks the link and watches the video as it is downloaded to his computer.

This technique has some advantages. Because the file doesn't actually reside in the recipient's inbox, there's no danger that it will push the size of the inbox over its limits. Also, streaming video begins to play almost immediately after you've started downloading it, rather than forcing you to wait for a file to completely download before it can be viewed.

Have someone else host your video. There are hosting companies out there that will stream your videos from their servers. One such company is Sorenson Multimedia, one of the parties involved in the aforementioned Give Thanks America project. Sorenson offers a streaming video service called Sorenson Veast for as little as $49.99 a month, which provides 256MB of space and lets the user stream 2GB per month.

Do it yourself. One alternative to having your streaming media hosted is to host it yourself. This requires a server and streaming video server software, such as RealVideo Server (http://www.real.com) or QuickTime Video Server (http://www.apple.com). With this option there are no size restrictions and no costs besides Internet service and the one-time cost of the server and software. Unfortunately, video server software can be quite expensive (Real's server software, for example, retails for almost $3,000), and setting up a server and configuring the software is pretty complicated.

■ **Show It With Email.** If you follow these tips and experiment a bit with different file formats, you can easily produce a 1-minute movie that even someone with a slow dial-up connection can download. So whether your video is meant to introduce the grandparents to the new addition to the family, show off the talents of a family pet, or say "I love you" to someone stationed overseas, it is now possible to send these important messages via email. The technology is here and readily available, so what are you waiting for? Go email some movies. LS

by Josh Brown

Candid Camera . . . Web-Style

Web Cameras Add Features To Become Multipurpose Devices

Web cams were once little more than expensive novelty items for a PC, capable of black-and-white video displayed in a postage stamp-sized window on your monitor. If you were lucky, you may have even known one of the four other people on the planet who also owned one of these dubiously useful gizmos and shared the odd evening watching each other in choppy, grainy black-and-white windows via a sputtering 56Kbps (kilobits per second) Internet connection.

That's enough gushing about the old days.

Although Web cams are hardly standard PC equipment, improvements in the technology have made them more flexible and more useful than ever. Modern Web cams for PCs boast significantly improved resolution, speed, and versatility over their early black-and-white cousins. Part of this improvement is due to the continued evolution of our PCs, which are now far faster and easily capable of handling the demands of PC video. Other improvements, such as the USB (Universal Serial Bus) specification, coupled with the latest Plug-and-Play capabilities the most recent Windows OS (operating system) has to offer, have made Web cams easier to install and use than ever before. Even though we may not convince you that you need a Web cam, we bet we can make you want one.

Web Cameras 101. Web cams first appeared as cyclopean, tennis-ball sized gizmos designed to sit on your monitor and shoot video of your face as you chatted on the Internet. Because early Web cams were generally marketed as low-cost videoconferencing tools aimed at casual home Internet surfers, they adopted the name "Web cams." Generally speaking, a Web cam can be virtually any small, inexpensive (generally less than $150) video camera that connects to your PC and transfers video to it.

Web cams connect to a PC through parallel ports, serial ports, video capture cards, or USB ports, with USB being the most common and preferred connection method for modern Web cams. Most Web cams now also have built-in microphones for voice communication and come with some form of simple video capture and/or photo-editing software.

The newest breed of Web cams are no longer limited to being tethered to a PC, either. You can detach these Web cams from their cradles and take them with you, which lets you snap still pictures, store them in the camera's memory, and transfer the pictures to your computer when you reattach one of these Web cams to its cradle.

The improvements don't stop there, either. This detachable breed of Web cam has the added flexibility of shooting short video (with sound) and/or recording voice annotations along with pictures.

The lines that separate Web cams, digital cameras, and digital video cameras have blurred significantly.

Shopping For The Perfect Cam. As a result of the crossover among digital camera technologies, shopping for Web cams requires understanding some of the same basic terms and features as shopping for standard digital cameras or video cameras.

Digital pictures—still pictures and video—are measured in resolution expressed in pixels. The greater the number of pixels, the more detailed, refined, and higher quality the image will be. Although high-end digital cameras take pictures at resolutions as high as 2,048 x 2,048 pixels, most Web cams are limited to snapping still shots at resolutions of 640 x 480 pixels, but some can go higher.

Web cams typically shoot video at a maximum resolution of 640 x 480 pixels at 30fps (frames per second), but only while connected to a PC. Web cams can only deliver video at 30fps (considered the minimum resolution for relatively "smooth" video) while connected to a PC because they need the PC's memory and resources. After detaching most detachable Web cams from the PC, they can only shoot video at about 15fps. And depending on the resolution, detachable Web cams have enough memory for roughly 15 to 90 seconds of video.

Like digital cameras, the number of pictures a detachable Web cam stores depends on how much memory it has. Newer, detachable Web cams include built-in memory and/or memory cards storing as much as 16MB of data. The more memory, the greater the number of pictures the camera stores when it's portable. When the memory reaches capacity, it's time to take the camera back, attach it to your PC, and download your pictures to your PC.

Modern detachable Web cams also boast a range of additional features, such as multisnap modes for taking several pictures very rapidly, built-in flashes with red-eye reduction, extensive software packages for video and photo editing, and the ability to record audio on the go.

Keep An Eye On The Future. If you plan to buy a Web cam, we generally recommend buying the most fully featured Web cam you can find in your price range, and whenever possible, spend the extra dough and get a cool detachable Web cam. Although the least expensive (and least flexible) Web cams cost less than $40, you'll quickly find these Web cams have too many limitations. But if all you're interested in is

showing your face on the Internet while you chat, by all means take the low road and buy one of the least expensive Web cams.

Otherwise, you should definitely consider spending more for a detachable Web cam. Buying any PC peripheral with a minimalist mindset frequently results in a desire to upgrade later. If you buy a low-end Web cam now, you might find yourself wishing you had one of the more expensive, detachable Web cams later when you want to take it to your son's soccer game or use it to take a snapshot of your cat in the next room so you can create your own customized wallpaper for your Desktop.

Consider this: The next time your cat strikes one of those irresistible poses, you could just quickly detach your camera, rush to the family room, snap a photo of your cat, and then reattach the camera and transfer the picture to your hard drive—all within seconds.

Don't be afraid to spend a little more now for technology offering superior flexibility; you're bound to find ways to use it, even if you don't think you will. Besides, the price difference between the least expensive Web cam and the most high-end Web cam is usually no more than $100.

What To Do With Web Cams. Early Web cams were a great idea, but probably ahead of their time. However, the growing popularity, ease-of-use, and convenience of the Internet have made Web cams increasingly attractive as peripherals, especially now that many have new features and capabilities.

Videoconference and socialize. One of the most common uses for Web cams is still basic videoconferencing and communication, which users achieve by using Internet chat programs in conjunction with Web cams so participants can see one another. Videoconferencing across the Internet is a great way for friends and family to keep in touch without racking up long-distance phone charges. But the quality of this experience is still highly dependent on the quality of the computer equipment both parties use and, more importantly, the quality and speed of the participants' Internet connections.

Basic Features At A Glance

For a quick comparison of the most popular cameras on the market today, we gathered all the pertinent information and put together this chart. All the Web cameras listed here are USB (Universal Serial Bus) cameras, and some include additional features as indicated. Of the specifications we listed, please note that 30fps (frames per second) is considered the minimum rate you'll need for relatively "smooth" video. We used the prices listed at the manufacturer's Web sites, but street prices found in retail outlets can be as much as 10% to 20% lower.

	Cameras	Still Shot Resolution	Max Video Resolution & Frame Rate	Memory	Other Features	Price
Logitech (http://www.logitech.com)	QuickCam Express	352 x 288	320 x 240 at 30fps 640 x 480 at 15fps	N/A		$49.95
	QuickCam Web	640 x 480	320 x 240 at 30fps 640 x 480 at 15fps	N/A	Built-in microphone	$79.95
	QuickCam Pro 3000	640 x 480	640 x 480 at 30fps	N/A	Built-in microphone	$99.95
	ClickSmart 310	352 x 288 (detached) 640 x 480 (attached)	176 x 144 at 15fps (detached) 640 x 480 at 30fps (attached)	2MB built in	Built-in microphone	$79.95
	ClickSmart 510	1,280 x 960 (detached or attached)	320 x 240 at 15fps (detached) 640 x 480 at 30fps (attached)	8MB removable card	Built-in flash and microphone; removable memory cards; multisnap mode	$149.95
Creative Technology (http://www.creat.com)	WebCam	352 x 288	352 x 288 (frame rate not specified)	N/A		$29.99
	Video Blaster WebCam Plus	640 x 480	640 x 480 at 15fps	N/A		$49.99
	Video Blaster WebCam Go ES	640 x 480 (attached or detached)	640 x 480 at 15fps	8MB built in	Adjustable time delay	$69.99
	PC-CAM 300	352 x 288 (detached) 1,024 x 768 (attached)	352 x 288 at 30fps 640 x 480 at 15fps	8MB built in	Multiple and adjustable time delay shots; digital voice recorder; built-in flash and microphone	$99.99
	PC-CAM 600	1,280 x 960 (detached or attached)	352 x 288 at 15fps (detached) 640 x 480 at 30fps (attached)	16MB built in	Multiple and adjustable time delay shots; digital voice recorder; built-in flash and microphone	$149.99

Though past experiences with slow Internet connections and Mesozoic Web cams made many of us skeptical of videoconferencing via the Internet, our first few attempts at videoconferencing while using a high-speed DSL [Digital Subscriber Line] connection were surprisingly successful. True, it wasn't nearly as picture-perfect as movies often depict this mode of communication, but nevertheless, our experiences were very positive. Voice communication was clear and audible, and although the video was somewhat grainy, we found it to be more than adequate. The joys of communicating long distance (and hands-free) with video are more satisfying than you might think. As broadband connections become more prevalent, true videoconferencing via voice and video will become a viable alternative for more of us.

Take snapshots. Do you take photos with a traditional camera, develop the photos, and finally scan them with a flatbed scanner to transfer digital copies of them to your PC? If you're still transferring pictures to your PC with this lengthy (and dated) process, it's time to explore the detachable Web cam alternative. Detachable Web cams are the perfect (and inexpensive) tool for taking quick, easy snapshots and transferring them directly to your PC.

Then, after storing them on your hard drive, post the pictures (or video) to your Web site or email them to friends. Web cams are the perfect tool for new parents to show off their baby to the rest of family, either by posting pictures on a Web site or videoconferencing with Grandma. Or take the camera to your child's soccer game and email a snapshot of the game-winning goal to your family when you get back to your PC.

Security purposes. In addition, you can use carefully placed Web cams to monitor your home in a variety of ways. For example, you could place a Web cam in a baby's room for easy audio and video monitoring. You could wire a Web cam outside your front door for surveillance of your porch (or mount Web cams around strategic locations in your home). You could even place a Web cam within view of your yard, a dog run, or a room for the cats, and transfer its stream of pictures directly to your own private, password-protected Web site, letting you see what's going on back at the house from work.

All of this is certainly *possible*, but it may not be very practical for a lot of us. Taking into account the fact that a Web cam generally needs to be connected to a PC, placement of a Web cam and PC can be tricky, especially if you don't want the PC in plain view where it can be easily accessed or shut off. Plus, truly innovative uses require significant overhead for such items as multiple PCs, network cabling, and possibly a server. For more information, see "We're Watching You" on page 130.

Gaming. Pictures are worth a thousand words. Seeing the look on an opponent's face, wallowing in the defeat your hands delivered, is infinitely more satisfying than a strip of text. The experience is even better if you're using voice communication to hear your gaming opponents

The PC-CAM 600 from Creative Technology pulls triple duty as a portable camera, Web camera, and audio recorder.

cry for mercy and curse your family five generations back after you frag them for the eighth time in Unreal Tournament.

Although Web cams certainly hold a tremendous amount of potential for gamers, they don't widely use the technology. Videoconferencing eats too much network bandwidth (even with high-speed connections), and gamers generally don't want to sacrifice frame rates, ping times, and the quality of their connections just to listen to their buddies during a game.

But with the popularity of multiplayer gaming and team-based gaming, the technology may soon improve to a point where using Web cams becomes more desirable for hardcore gamers. For the time being, Web cams are better suited to casual Web surfers and Web gamers playing low-end multiplayer games, such as chess, checkers, backgammon, and the myriad of titles found on sites such as Microsoft's Gaming Zone (assuming you can find someone who wants to look at your face and/or listen to you while you play a game).

Web Cam Family Feud. Despite their improved flexibility, Web cams never became the staple PC peripheral manufacturers had hoped, and as a result, there are no longer as many manufacturers in the market competing with one another. Of the few Web cam manufacturers out there that still actively produce and sell Web cams, Logitech (http://www.logitech.com) and Creative Technology (http://www.creaf.com) are still standing tall, and each have a family of Web cams from which to choose.

Logitech offers five different Web cams. At the low end ($49.95) is QuickCam Express, which, aside from the fact that it has a USB connection, is not far removed from the early ancestors of Web cams (it doesn't even sport a built-in microphone). A step above the QuickCam Express is QuickCam Web ($79.95), which offers a privacy screen for covering the camera lens and a built-in microphone for true videoconferencing. The pinnacle of the QuickCam line ends with the QuickCam Pro 3000 ($99.95), which boasts improved picture and video capture resolutions over its less expensive cousins, as well as a built-in microphone and improved base.

Logitech's detachable Web cams start with ClickSmart 310 ($79.95), which has 2MB of built-in memory for storing as many as 160 photos (at the lowest resolution) or 15 seconds of video. Logitech's most powerful and versatile Web cam is ClickSmart 510 ($149.95), which is capable of capturing the highest picture and video resolutions (1,280 x 960) of the Logitech line. The ClickSmart 510 also has a built-in flash and stores pictures on a removable 8MB SmartMedia card.

Creative also offers a family of cameras. WebCam ($29.99) is one of the least expensive (and least flexible) Web cams you're likely to find. A step up from the WebCam is Video Blaster WebCam Plus ($49.99), which boasts improved capture resolutions over WebCam for video and still pictures. Video Blaster WebCam Go ES ($69) looks like the WebCam Plus, but you can detach it from its cradle, plus it has 8MB of built-in memory for storing snapshots.

At Creative's high end sit the PC-CAM 300 ($99.99) and the PC-CAM 600 ($149.99). The PC-CAM 300 is detachable and includes 8MB of built-in memory for storage, in addition to improved resolutions above and beyond the WebCam Go ES model. The PC-CAM 600 boasts even higher video resolutions and an additional 8MB of memory, for a total of 16MB of storage.

As you can see, a Web cam is available for virtually every budget, with prices capping about $150 for the most expensive models. And as you might expect, we recommend the high-end cameras for their flexibility and picture quality. Still, regardless of which model you buy, we guarantee you're bound to find fun and interesting ways of using it. LS

by P. Bryan Edge-Salois

We're Watching You

Use Web Cams For Security

Web cams, those lens-equipped, inexpensive, oversized ping-pong balls that sit on your monitor, are getting to be like food processors. Almost everybody has one, but most of them end up gathering dust in a closet.

Web cams let you transmit live video across the Web from your desktop, but the most common applications for Web cams seem to be streaming porn sites or lame, 24/7 views of someone's goldfish tank. We suggest a more productive application: home and business security. Footage of intruders can be recorded straight to your hard drive; uploaded to the Internet for viewing by you, neighbors, or the police; or both. The technology is incredibly cheap and the tools you need may already be under your nose.

So dust off that old Web cam or go grab a new one. A myriad of entertaining and safety-related applications are only a blink away.

Are All Web Cams Created Equal? Not quite. Security is an important application, and while all you may need to know is that *someone* is invading your space, you may also want to know *who* that person is. Particularly if you plan on handing footage over to the police, you'll want the best image possible to help identify the culprit. Web cams are not known for their high picture quality. We've reviewed quite a few, and the differences among even the sub-$100 models are substantial.

We don't have space in this article to conduct lengthy hardware reviews, but keep a few key camera facts in mind as you prepare to purchase or set up your Web cam hardware.

Frame rate and resolution. As with motion picture film, video displays at a certain number of frames per second (generally abbreviated as fps). Faster frame rates look more lifelike, which is why televised video generally plays at 25fps to 30fps. With computers, every frame requires a certain amount of data processing, depending on the size of the frame. Because of the amount of data involved, most Web cams cannot output 30fps at a resolution greater than 352 x 288. After all, 352 times 288 is roughly 100,000 bytes of data (and much more than that, when you consider color depth); at 30fps, this works out (even without color) to over 3Mbps (megabits per second), a data rate much greater than that provided by DSL (Digital Subscriber Line) connections.

For this reason, PC-based video streams are heavily compressed, frame rates are lowered, the number of colors is restricted, and so on. Developers use every trick in the book to try and keep your Web cam's video feed looking as good as possible, but don't expect to achieve your camera's top frame rates and resolution.

Because your objective with security is to increase image clarity rather than to preserve realistic video motion, it's best to increase resolution, lower compression, and drop the frame rate. Especially if you plan on viewing Web cam security footage over the Internet, fast frame rates are impossible, so seek instead to optimize your image clarity.

Interface. If you're buying a used or discounted Web cam, you may run across models with a parallel interface. Parallel predates and is much slower than USB (Universal Serial Bus). A slower interface means that less video data is able to pass from the camera to the PC in a given period of time. You may also come across a serial interface camera, but this is even slower than parallel. USB is the way to go for home use.

If you're planning to use Web cams for your business, you might want to consider stepping up from USB to either an Ethernet-based camera (which can handle up to 100Mbps) or a card-based product from a company like Winnov (http://www.winnov.com), in which the camera plugs into a proprietary PCI (Peripheral Component Interconnect) or PC Card adapter. Until USB 2.0- and IEEE 1394-based Web cams enter the market, these Ethernet and proprietary card cameras deliver the best data rates available.

Other considerations. Most Web cams use fixed focus lenses, meaning that everything between a certain minimum and maximum distance will be in focus. For general security use, this is probably ideal since you'll probably want to cover most of a room. However, there may be times when you only want the focus to be roughly an arm's length away, just enough to reach from the camera on your monitor to whomever is sitting in your chair. Such restricted depth of field can yield better focal clarity, but manual focus abilities may also raise the camera's price.

Other camera properties can be controlled by software. Exposure control is fairly universal, but color correction, white balance, and the amount of compression used may not be; if you're picky about such matters, make sure to check before you purchase a Web cam. Also

keep a careful eye on the **lux rating**, which measures the amount of light necessary to maintain an adequate image. Lower lux ratings mean the camera will perform satisfactorily in lower light, a key consideration if you're doing security monitoring after hours.

The new Web cams, like this model DSB-C300 from D-Link (http://www.dlink.com), are sleek and flexible and capture video in color.

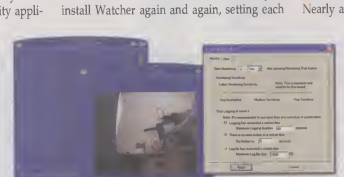
Watcher: Security On A Shoestring. Surveillance is no longer a bad word for most people, and security, whether it be national or neighborhood, is paramount in everyone's mind. Following September 11, security applications for consumers rocketed in popularity. Some of these applications come from well-known companies, but many come from virtual unknowns.

For example, take Watcher and RemoteView from Digi-Watcher (http://www.digi-watcher.com), a pair of security applications designed and distributed by a group of Singapore shareware authors. For only $35, these two programs pack a lot of security power and are one of the best ways to make use of a Web cam currently sitting idle in your drawer.

Watcher keeps a constant eye on your Web cam's field of view. Once the software is installed, you merely position your Web cam to observe an area, such as the front entrance or your desk, and start the application. Watcher will automatically configure a video window size that best suits your system, then place you at the Capture screen, which features three functions: Record (which simply captures and saves video clips), Monitor, and Listen.

Click the arrow below Monitor and, after a pause, Watcher will start analyzing the Web cam's live footage. When it notices motion (a significant number of pixels changing from frame to frame), the program begins recording. You can set the options for Monitor by clicking the light blue oval in Watcher's top-left, then selecting Monitoring Setting. Here you can select Monitor's sensitivity level, maximum logging duration, and when to stop recording. Also under the blue oval menu, you'll find an option called Video Format. Click this, then look to the middle of the Video Property window at the Video Compression Settings area. The default here is for high compression, but since your emphasis for security is most likely on clarity, change the setting to Low Compression Ratio, Best Quality. If you're trying to balance clarity with frame rate and have a fairly fast CPU, leave the setting at its default. Slower systems may benefit from selecting the Medium Compression setting.

With Monitor, you can point your Web cam at your office desk and set Monitor to watch for intruders. When someone enters the field of view, Watcher saves the clip in its log where you can bring it up for later perusal. If you want to use more than one Web cam, just install Watcher again and again, setting each new installation to watch a different camera. There are no additional charges for running multiple copies.



Affordable and surprisingly feature-rich, Digi-Watcher offers a pair of applications, Watcher and RemoteView, that not only let you record intruders captured by your Web cams, but also send live footage to any PC running the same software. Best of all, there is no limit to the number of supported cameras.

Recording intruders at the scene of the crime is handy, but being able to watch them in real-time is even better. After you've downloaded and installed RemoteView, click the arrow in Watcher under Listen. This tells Watcher to keep a virtual ear open for incoming calls from another Digi-Watcher user; in this case, that would be you, connecting from another PC. The Web cam feed from the first PC is relayed to the second via RemoteView.

If you were at a friend's house for a few hours and wanted to see what your kids were up to, you could set a Web cam to watch the living room, then start the Listen function on the home PC. From your friend's house, run RemoteView, connect to your home PC either via the Internet or modem-to-modem, and see exactly what the Web cam in your house sees. Novices may need to refer to Digi-Watcher's online help for instructions on how to configure RemoteView, but compared to several other remote surveillance applications we've seen, Digi-Watcher's software is a breeze.

"Soon, we will provide more advanced options for advanced users," says Digi-Watcher's Mable Ryan. "For example, you could specify different frame rates for different modes of operation (recording, monitoring, and streaming) to optimize Watcher's performance. You could also specify trade-offs between compression ratio, CPU usage, and visual quality."

Dynamic Duo: QuickCam & SpotLife. Nearly all Web cams come bundled with software. Logitech's (http://www.logitech.com) Quick-Cam Pro 3000, for example, comes with an application called QuickCam, which handles all Web cam tasks tied to the local PC. But Logitech added another layer of functionality by partnering with SpotLife (http://www.spotlife.com), the same service that enables Yahoo!'s free video email application (http://promo.yahoo.com/videomail). QuickCam helps capture and save video clips, and the clips themselves can be shared by uploading them to SpotLife, where they can be viewed on demand. The service can also stream live video and post periodic snapshots from your camera (a service called webcamming). If you're looking for a low-bandwidth way to monitor your desk from afar to make sure no one is using your PC, setting up a webcamming routine that posts images every 10 or 15 seconds is a low-bandwidth, cost-effective way to ensure peace of mind.

The first thing you need is a SpotLife account. Beyond the free 30-day trial, all subscriptions include unlimited webcamming. For $2.99 per month, you get 10MB of storage space for video clips and 60 minutes of live video streaming. The most expensive account, $99.99 per month, offers 200MB of storage and unlimited live streaming.

You won't find any functions that remotely alert you of an intruder's presence or automatically stream alert footage to the Web. However, you can use the Activate Motion Detector tab to instruct QuickCam to watch for motion in your camera's field of view and start recording when a certain threshold of movement is reached. In the Live View window, make sure you set the resolution to 640 x 480. In Start Monitoring, click the arrow in the lower-right and select Preferences. The Notification tab lets you create or select a sound to play when the motion alert goes off. ("Smile for the camera while I'm calling the police, Mr. Intruder!" or "Get off my keyboard, you stupid cat!" are two perennial favorites.) The Auto-Monitor tab helps you set a schedule when QuickCam will automatically start recording. All clips are saved in a Motion Files gallery as AVI (Audio-Video Interleaved) files. You may not know who your intruder is while he's at your desk, but you can discover his identity when you return.

Broadcast Live With Inetcam. Most products that let you stream video across the Web are server-based portals such as SpotLife. Inetcam (http://www.inetcam.com) takes a different approach, using a peer-to-peer design that in effect makes your PC the video server, broadcasting on-demand streams to the world.

With a product like Inetcam's iVISTA Personal Security ($99.99), your Web cam becomes an always-on surveillance camera. When you surf to *youraccountname.inetcam.com*, you'll see a live audio/video stream being served up by your PC. This does require an Inetcam subscription, but the first year is included with your purchase and renews for $29.99 annually thereafter.

"We believe peer-to-peer is simply a more efficient way to do video over the Internet," says Jack Corrao, vice president of business development at Inetcam. "In a survey we did, we found 75 different streaming video vendors. But of those, only three do peer-to-peer. The portal was a concept from three or four years ago. Peer-to-peer is today's technology."

iVISTA Personal Security lets you broadcast one video and audio stream. Alternatively, you can broadcast a live view of your PC's Desktop, which is handy for watching what an unauthorized user is doing with your system. If someone is digging through your Outlook Inbox, you can see what files are being accessed from wherever you happen to be viewing your Inetcam site.

The main security features of iVISTA start with motion detection. As with Digi-Watcher and SpotLife, you can record motion-activated video clips, configure sensitivity, and instruct the program to play prerecorded messages. One iVISTA advantage is that you can set up areas of the Web cam's view in which to ignore motion detection, a great way to filter out pet movement or trees blowing in the wind. Alarm functions can be scheduled to run only at certain times. Best of all, though, are iVISTA's notification capabilities. Motion alarms can trigger an email message to alert you to the potential break-in so that you can rush to the nearest Web-enabled computer. The program will even stream video in real-time to your cell phone if you happen to have a WAP (Wireless Application Protocol)-compliant model with graphics support.

We found iVISTA very easy to configure and use. Keep in mind, though, that the size of your video window and the number of frames per second in your stream will depend heavily on your system's upload speed. A conventional 56Kbps (kilobits per second) modem only uploads at a maximum speed of 33Kbps. According to Inetcam's Jack Corrao, one 20fps

I, Security Geek

Got $3,000 and some spare time on your hands? If so, you can indulge in what may be the oddest Web cam security product of them all: the Spy-Cye robot from Personal Robotics (http://www.probotics.com). Until recently, this wheeled wanderer, equipped with a wireless X10 video camera, "home base" charging station, radio pod, and Map-n-Zap Windows software, cost only $995. The price recently tripled to $2,995 but what the heck, you now get a Cye logo T-shirt with your order.

Spy-Cye is wirelessly controlled by the PC. Map-n-Zap presents a blank grid that represents its environment. You control the robot with your mouse. As Cye encounters obstacles, features begin to appear on the map grid, which can then be further edited by the user. Eventually, a detailed floor plan of the home or office emerges, and you need only click on a point to send Cye zipping off to its destination. The robot's Web cam beams audio and video back to the desktop. With an account at http://www.web-bots.com, you can not only see Cye's camera view over the Web but also control it from anywhere in the world. A "Zap" is a sort of program you can create to make the robot perform a complex sequence of tasks, such as going into the dining room, waiting for 10 minutes, going to the bedroom, and staying put for up to three hours unless someone nudges Cye, in which case it should return to its base.

Without question, Spy-Cye is fun, educational, and irresistible for anyone interested in robotics. As a surveillance tool, well, it might be fun to send the robot down your office hallway to check up on employees, but one stomp from a thief's boot and you can kiss your three grand goodbye. □

You can program the Spy-Cye robot to roam your home or office and wirelessly transmit everything it sees and hears back to your PC either for recording or posting to the Web.

stream requires 200Kbps of bandwidth, so be prepared to compromise unless you have a very fast broadband connection. Typical cable or DSL connections let a single stream upload at a steady 5fps to 6fps, with about a two-second lag time from capture to viewing. Also note that iVISTA has been optimized to broadcast much more efficiently when running on a Pentium 4-based PC.

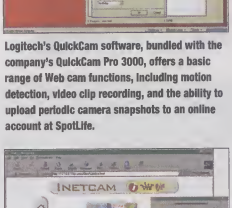
If you want to run multiple cameras on iVISTA, say with a Web cam in the office and another in the entryway, we recommend getting the iWATCH kit, which retails for $399.99 but is generally sold on the street for just under $300. The package includes two color Web cams, a four-port camera switch, an internal capture card, cabling, camera mounts, and iVISTA software. You can add two more cameras ($149.95 each for color, $89.95 for black and white), and the capture card ensures much better quality than a USB configuration.

■ **Got Brinks? Get Xanboo.** Nearly all Web cam security products have an obvious flaw: A camera pointed at your front door won't help if a thief breaks in through the side window. This is why conventional security systems continue to sell. They not only offer optical motion detection but sensors for home entry points, a deafening alarm, and an emergency call to the police. If you could accomplish the same thing (and a lot more) with a handful of relatively inexpensive PC parts, would you do it? If so, check out Xanboo (http://www.xanboo.com).

Almost too good for the price, Xanboo's $49.99 Internet Home Management System (sometimes called the Basic Starter Kit) includes a color Web cam, 60-foot data cable, software, and wireless-enabled system controller. The controller provides connections for up to four cameras and listens for signals from Xanboo's wireless sensors ($19.99 each) for door or window motion, water, and sound. Software setup involves only seven steps that guide you from camera detection through registering a Xanboo.com account and final testing. The process is pretty simple, but have some zip ties handy to tidy up all of the cabling.

The Xanboo PC interface lets you view live video and capture both clips and snapshots, but the heart of Xanboo's package is the Xanboo.com service, which starts at $9.95 per month. This covers 5MB of video storage space and unlimited alarm notifications to your email, including to email-ready portable wireless devices. If you're on vacation and have a friend watching your home, just dip into your Xanboo.com account, click the XanControl icon, then select Notification Profile and modify the email address from yours to that of your friend. The online XanFolder area lets you store video and other files for sharing with others. The XanBoard area keeps a time-stamped log of all Xanboo device events, and you can also view live video from any of your cameras.

Logitech's QuickCam software, bundled with the company's QuickCam Pro 3000, offers a basic range of Web cam functions, including motion detection, video clip recording, and the ability to upload periodic camera snapshots to an online account at SpotLife.



The security features in Inetcam's iVISTA and iWATCH products are excellent. The software turns your PC into an always-on surveillance system, letting you view your Web cam footage in real-time from anywhere in the world.

For now, the Internet Home Management System remains the best of all Web cam packages for security. Once the cameras transition from wired to wireless, the Xanboo package will be practically perfect.

■ **Brewing Tomorrow's Web Cam Security.** Apart from relatively minor improvements in camera quality and increased broadband speeds, there isn't a lot in store for Web cam innovations unless you look at mobile devices. Currently, cellular networks are upgrading from second-generation 14.4Kbps data rates to 2.5G 144Kbps technologies, a tenfold increase in bandwidth. With all of this speed, it'll be possible to stream video over cellular networks. You could send video from your phone, as DoCoMo's FOMA products (http://foma.nttdocomo.co.jp/english) already do in Japan, or you could use your phone to view real-time surveillance video from your Web cams.

You can already experience this future today thanks to Inetcam's iVISTA. With iVISTA, Web cam video can be streamed to any BREW (Binary Runtime Environment for Wireless)-compatible phone, such as the Sharp (http://www.sharp-usa.com) Z-800, or any handheld device capable of running Java, such as a wireless-enabled Pocket PC. Just think of the peace of mind this could provide. Parents can check up on babysitters at will and vacationers can make sure all is well with their homes and pets from anywhere roaming allows.

According to Inetcam's Corrao, 2.5G cellular networks should be able to deliver 8 to 10fps wirelessly into the palm of your hand. Resolution may suffer until high-definition LCDs (liquid-crystal displays) enter the handset market, but the full-resolution footage can be captured simultaneously to your home PC or forwarded to law enforcement agencies.

■ **Technology To The Rescue.** As George Orwell imagined, surveillance can go a long way in the wrong direction. Those X10 pop-under ads all-too-constantly remind us that Web cams are able to spy not only on those we love but also on those we want to love, so to speak. Webcamming and streaming let anyone become the Big Brother of his or her little world, and it's important not to let surveillance and security get confused with invasion of privacy or outright paranoia. As Web cam use becomes easier and more prevalent, the danger of its misuse increases.

For the rest of us levelheaded, responsible people in need of better security for our homes and workplaces, there has never been a better time to harness the power of PCs and Web cams to help protect those we love and that which we work for. Best of all, these technological precautions are a blast to set up and operate. And if the worst intruder you ever catch turns out to be the cat napping on your monitor, then at least your security efforts will help explain why your displays keep burning out. LG

by William Van Winkle

Digital Projectors

Coming Soon To A Theater Near You

The next time you walk into a movie theater, you may be seeing more than just a film. You may be seeing the future of cinema.

Digital cinema is slowly starting to make its way into theaters across the country. It's easy to see why. With its clear picture, ease of distribution, and other benefits, digital cinema is superior to traditional film in many ways. But before digital cinema becomes the standard across the country, the movie industry must overcome several obstacles. Here's a look at why digital cinema is an exciting opportunity . . . and what's holding it back.

What Makes Digital Superior? Digital cinema has numerous advantages over traditional film. First, consider how traditional movies make their way from the studios to the theaters. The studios must print, pack, and ship the reels to each theater. The theater staff must receive the film reels, assemble them, clean them, and, once the film run is over, ship the film back to the studio (or another theater). The studios and theaters often repeat this process many times.

Digital technology simplifies this process. Studios can transmit movies via several media, including DVD-ROM, copper fiber, or satellite feeds. This can save time over the traditional delivery process because films can be shipped almost instantaneously and theaters don't have to assemble the reels. This can also save money in the long run, and the stakes regarding this possibility are very high. The film industry spends an estimated $1.5 billion per year to make and ship all that film around the world.

Next, consider the display (the movie) itself. Digital film doesn't deteriorate over time the way 35mm film does; the 10th or 20th or 50th copy of digital film looks just like the original, with images that are just as clear and sharp.

There are a number of advantages related to business issues, as well. If theater owners don't have to wait long to receive a film delivery, they have more flexibility in film scheduling. Suppose a multiplex is showing several films, including Picture A and Picture B. Picture A isn't performing all that well, so the theater owner wants to stop showing it and replace it with another copy of Picture B. With traditional film, the theater owner must find a way to get another copy to the multiplex, and this process can be cumbersome. But with digital delivery, the theater owner can obtain a copy with just a few mouse clicks (provided he has the proper permission from the studio, of course.)

Flexibility also extends to an important marketing issue. Movie trailers are one of the best ways to advertise upcoming films. A studio typically puts its own trailer on before a film, but each theater has some discretion when it comes to which other trailers it plays. If theaters receive trailers digitally, they can more easily customize the trailers to their own demographics and, therefore, attract more paying customers.

But it isn't all sunshine and roses.

"Keep in mind that for every plus, there's a potential minus, and that's without even considering digital capture," says Charles S. Swartz, the executive director and CEO of the ETC (Entertainment Technology Center; http://www.etcenter.org), an organization whose mission is to discover, research, and develop numerous entertainment technologies. "Digital technology is always changing. In the home, that's a plus because it leads to better and improved technology.

"But in the cinema, it complicates the way the pieces fit together," he adds. "We're in a phase of this because it's immature and new, where it's up to all the different players to work together and manage this in an organized way."

Underlying Technology. One look at the underlying technology illustrates just how young this industry is. Right now, all of the digital cinema projectors on the market rely on the same chip. The DLP (Digital Light Processing) chip from TI (Texas Instruments; http://www.ti.com) is based on TI's DMD (Digital Micromirror Device). It is an array of thousands of square, microscopic mirrors, each about one-fifth the size of a human hair in length and width. Each mirror, which corresponds to one pixel on the theater screen, tilts diagonally about 10 degrees. When light is shining through, the mirrors flip very rapidly, in the range of thousands per second.

Doug Darrow, TI's business manager of DLP Cinema Products, says the technology uses three chips, each one dedicated to a primary color. The images are overlaid on top of one another, and the result is a picture where the colors and contrasts are bright and sharp. Darrow says the company has been working on the chip for the past five years in a variety of applications, but that applying it to digital cinema (as opposed to home projectors) has really put it to the test.

"We knew the technology was well-suited to high-performing video applications, so we started a dialogue with Hollywood," Darrow says. "And when we try to do something so demanding visually, we learn more about the technology and try things we might not have tried otherwise."

Other companies are working on competing technologies. In March, for example, Kodak announced its Kodak Digital Cinema System, which uses a chip from JVC. This chip relies on LCD (liquid-crystal display) rather than mirrors. Kodak claims the newest JVC chip offers more than double the resolution currently available in digital cinema projectors.

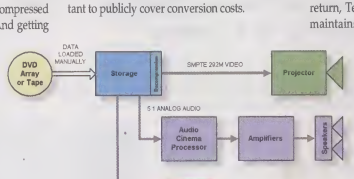
Companies are researching competing delivery methods, as well. Even after compression, the digital master can be as large as dozens of gigabytes. Paul Miller of the Digital Cinema Lab, part of the ETC, says a typical film is compressed to between 50GB and 60GB of data. And getting the data from a studio is obviously more complicated than simply sending it over a dial-up Internet connection. Companies are working on DVD-ROM discs, satellite transmissions, broadband connections, and holographic data storage as possibilities. Boeing Digital Cinema, for instance, announced in May that it was using satellite, fiber optics, and physical media technologies to deliver movies to 23 theaters.

And then there's encryption. Boeing Digital Cinema uses an encryption technology endorsed by NIST (National Institute of Standards and Technology) for protection of commercial and government information. Other companies are reportedly working on their own encryption technologies.

But no matter which underlying technologies the digital cinema system uses, once the movie gets to the theater, the setup is similar. A typical digital cinema system consists of just two objects: a server and a projector. The server loads the data, and the video transmits to a projector.

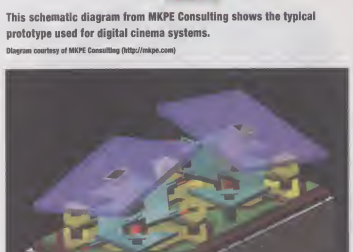
The Business Side. Sounds simple, right? But although a digital cinema system may only need a couple of pieces of equipment, those devices are expensive. The cost of buying and installing a new system is about $120,000 to $150,000. And that's partly why the movement from traditional to digital cinema has stalled.

Theater owners, for instance, are reluctant to plunk down that much cash on an investment that may not pan out. Many felt burned when they tried to convert to digital sound a few years ago; they installed one system, and then another type of system came along, requiring yet another investment. And because the systems were incompatible, some theater owners felt they paid too much for technology that became out of date far too quickly. Plus, even though digital cinema helps theater owners present a better product to their customers, they're skeptical about whether it will cover their costs. And so far, the studios as a whole have been reluctant to publicly cover conversion costs.



This schematic diagram from MKPE Consulting shows the typical prototype used for digital cinema systems.

Diagram courtesy of MKPE Consulting (http://mkpe.com)



The illustration shows an enlargement of two mirrors on Texas Instruments' DLP (Digital Light Processing) chip, one on and one off. Light hitting the "on" mirror will reflect through the projection lens to the screen. Light hitting the "off" mirror will reflect to a light absorber.

Diagram courtesy of Texas Instruments

There is another possible solution. Third parties, such as Technicolor Digital Cinema (http://www.technicolordigital.com), have started to enter the scene. Technicolor Digital Cinema's business model is based on the notion that theaters and studios share the cost, but neither owns the equipment; this eliminates issues of control. (Theater owners worry that if studios own the projectors, the studios will dictate what films play on them.)

Technicolor Digital Cinema's business model boils down to this: Exhibitors pay Technicolor Digital Cinema a flat fee per showing, which is based on auditorium size and other factors. In return, Technicolor Digital Cinema installs and maintains all in-theater digital cinema equipment, including the projector, the theater management system, and storage devices. But right now, it's anyone's guess as to which business model will win out—or what new models will emerge.

Where We Are Today. Despite all the uncertainty surrounding digital cinema, there are some clear trends. One is that the industry has a strong interest in setting standards. Computer users understand how important standards are; you know that your USB (Universal Serial Bus) device will work with your computer's USB port because they both adhere to certain standards. The same concept is true for digital cinema. Everyone involved benefits when a compression system is standardized to work with a projection system.

In April, seven major Hollywood studios announced they formed an organization whose primary purpose is to study and address the technical issues of digital cinema. Newco Digital Cinema could lead to standardization soon.

Another player in the standardization debate is SMPTE (Society of Motion Picture and Television Engineers; http://www.smpte.org). The SMPTE DC28 Technology Committee has studied the issue of standards for digital cinema for quite some time, but members have not yet reached any agreements.

Another clear trend is that theater owners are adding digital cinemas across the country on a weekly basis. At the time this issue went to press, an estimated 65 screens across North America, according to TI, are equipped with DLP Cinema Projectors. To see a list, visit the DLP Cinema Theater Search page (http://www.dlp.com/dlp/cinema/where.asp?rid=1). This list just might be your road map to the future of cinema. LS

by Heidi V. Anderson

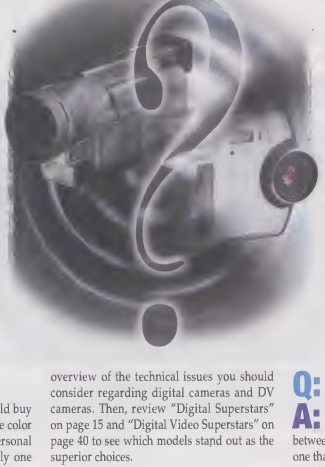
Digital Imaging Q & A

Answers To Questions About Digital Cameras, Photography & Video

Anyone can use a digital camera or DV (digital video) camera. But it takes someone with a certain amount of experience and education to use one effectively. We'll answer some common questions about the devices to help you get the education you need, but you'll have to get the experience on your own. Of course, that's the fun part.

Buying Considerations. Digital photography, whether of the still or motion-video variety, is not a cheap hobby. First you have to buy a camera, then you need to purchase storage media and extra batteries. Plus, you might decide to purchase a photo printer or video capture card so you can do something with your images. After using the camera for a while, you may find it necessary to purchase a few more accessories, such as a tripod or LCD (liquid-crystal display) hood. Add it all together, and you could easily spend more than $1,000 on equipment.

Given the stakes involved, it's easy to see why smart buyers have a lot of questions. Here are the ones they ask most often.



Q: Which camera should I buy?

A: Asking which camera you should buy is like asking what your favorite color should be. The answer is intensely personal and based entirely on preference. Only one person can answer this question correctly, and that person is you. Your friends, neighbors, co-workers, and relatives can offer advice and opinions that are worth considering, but ultimately you will have to make the decision yourself.

Fortunately, you can form an intelligent response without spending an inordinate amount of time on the subject. All you have to do is consider how you plan to use the camera, what you intend to do with the pictures or video footage you take, and how much you can afford to spend. The rest is legwork—or fingerwork, in this case. See "What Really Matters?" on page 11 and "Upon Further Review" on page 36 to get a complete overview of the technical issues you should consider regarding digital cameras and DV cameras. Then, review "Digital Superstars" on page 15 and "Digital Video Superstars" on page 40 to see which models stand out as the superior choices.

Q: What kind of printer should I get for my digital images?

A: Despite the convenience and benefits of viewing digital snapshots in an electronic format, users will always demand the ability to print their photos on paper. And no wonder: Only printed photos can be framed on a desk, taped to a refrigerator, mailed to a distant friend, or saved in a scrapbook.

The correct printer can help you get film-quality prints of your digital photos. For best results, get a printer that supports color printing at a resolution of at least 1,440 x 720 **dpi** (**dots per inch**; the number of individual dots of ink used in each inch of print). Avoid printers with multicolor ink cartridges. If you can, choose one that has individual cartridges for each of four colors: cyan (blue), magenta (red), yellow, and black.

Users who are really serious about printing their digital photos may want to consider getting a dye-sublimation printer designed specifically for that purpose. These printers use sheets of colored film rather than ink jets to produce color images on paper. The resulting prints are more natural looking and longer lasting than prints produced on an inkjet printer. You can get a dye-sublimation printer from Sony (http://www.sony.com), Olympus (http://www.olympus.com), Canon (http://www.usa.canon.com), and other camera manufacturers. Expect to spend between $300 and $700 or more for a dye-sublimation printer.

On a related note, you should use photo paper when printing your digital images. The photo paper is thicker and glossier than regular paper, which helps you print photos that look like they just came back from the film developer. Photo paper is expensive—you will typically pay 50 cents to $1.00 per sheet—but the results are worth it.

For more information about printers and digital imaging, see "Digital Photos Demystified" on page 117.

Q: What is the difference between optical zoom and digital zoom?

A: The difference between optical zoom and digital zoom is like the difference between a movie that is filmed on location and one that is filmed in front of a painted set. One is real, the other isn't.

More specifically, **optical zoom** involves a telescopic lens that actually magnifies the subject. **Digital zoom**, on the other hand, requires software to artificially enhance the image so that it appears to be a detailed close-up. How can it do that? The software essentially creates new data by examining the existing data and doing some mathematical guesswork. For example, if the software sees a pair of blue and yellow **pixels**

Print your digital photos with a dye-sublimation printer, such as the Canon CP-100 ($349), for better print quality than you'll receive with an inkjet printer.

Digital cameras and DV (digital video) cameras use a variety of flash memory formats, including the Memory Stick from Sony. It doesn't matter which type of flash memory your camera uses; all formats provide excellent storage quality.

Q: Can I get quality still images from a DV camera?

A: It depends what you mean by quality. A DV camera that supports still photography can certainly match the capabilities of a low-end digital camera. In other words, a DV camera lets you capture images that look great on a Web site, in an email message, or printed at a peak size of 4 x 6 inches. We recommend going the all-in-one route if you intend to shoot a lot more video footage than still photos. We also recommend this route if you have a limited budget and want both video and still photography functionality.

However, the fact remains that DV cameras are designed for capturing motion video, not still images. Indeed, the image capturing capabilities of a high-end DV camera pale in comparison to the capabilities of a midrange or high-end digital camera. If photography is one of your passions and you plan to print many of your photos, you need to invest in a digital camera.

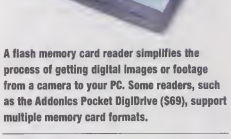
(dots of light) positioned next to one another, it may insert a green pixel between them.

An image enhanced with digital zoom technology may turn out looking just like its optically zoomed counterpart. Then again, it may not. Stick with a digital camera or DV camera that features optical zoom technology if you know you need to take a lot of close-ups.

Q: Will the type of memory I use have an impact on the quality of images or footage I capture?

A: No. The two things that will have the greatest impact on the quality of your images are your photographic skills and the capture settings on your digital camera or DV camera. A lot of practice can help you maximize the former; a lot of storage space will help you optimize the latter.

We suggest getting as much memory as you can afford when purchasing a camera. Buying an extra memory card is a good idea, too. Popular flash memory formats include CompactFlash, SD (Secure Digital), SmartMedia, and Memory Stick. CompactFlash cards provide storage capacities up to 1GB; the rest of the formats top out at about 128MB, though capacities are increasing all the time. Unless you plan to share your memory cards among multiple cameras or with other users, it really doesn't matter which type of memory you choose.



A flash memory card reader simplifies the process of getting digital images or footage from a camera to your PC. Some readers, such as the Addonics Pocket DigiDrive ($69), support multiple memory card formats.

Q: Which is better: Digital8, MiniDV, or MICROMV?

A: Each of these digital video formats offers particular advantages and disadvantages. MICROMV, for instance, is a compact format that helps manufacturers build products that are significantly smaller than the typical video camera. MiniDV, on the other hand, offers image-recording capabilities that beat the competitors hands down. Digital8 stands apart from the competition because of its lower price (a Digital8 camera is less expensive than its MiniDV or MICROMV counterparts) and its use of the ubiquitous 8mm and Hi8 analog tapes.

If image quality is all that matters, choose a MiniDV camera and media. Unfortunately, most users also have to take price and size into consideration. By giving careful thought to these three criteria, you should be able to decide which format is best for you. See "Upon Further Review" on page 36 for more information about the various digital video formats.

■ **General Usage.** The questions users are likely to ask about digital photography have little to do with trade secrets, such as when to use a flash and how far away to stand from a subject, and a lot to do with technical issues, such as how to prolong battery life and how to get photos from the camera to the PC. It seems as if the trick to using a digital camera is learning how to master the technology. The following questions and answers can help you with this, but for more detailed information about using your camera, see all of the articles in the first two sections of this magazine.

Q: How can I extend my camera's battery life?

A: The bane of digital photography is the battery. All those electronic components that make a camera work require a steady stream of electricity. Fortunately, you can take a few steps to prolong the time between battery replacements.

For one thing, buy quality batteries. Visit your local photography store and ask for the best batteries it has. The budget batteries may save you a few bucks in the short run, but you'll have to replace them so often that they'll end up costing you a bundle in the long run. Make sure you get the right battery for your camera, too. You might be able to fit a cheap carbon-zinc battery into your camera, but you'll get better performance and less risk of permanent camera damage if you use an alkaline or NiMH (nickel-metal hydride) battery instead. Read the users manual to determine what kind of battery your camera uses.

Another way to extend battery life is to turn off power-hungry features, such as the LCD and the flash. You also should keep the camera turned off when you're not using it and minimize your use of the image review features.

Thanks to three competing DV (digital video) formats, you can easily find a camera that meets your needs and budget. You'll receive the best image quality from a MiniDV camera, such as the Sony DCR-TRV27 ($999.99) on the left. When size matters, consider using a MICROMV camera, such as the Sony DCR-IP5 ($1,299.99) in the middle, which is small enough to fit in a shirt pocket. The economically minded will find that a Digital8 camera, such as Sony's DCR-TRV140 ($499.99) on the right, provides the most bang for the buck.

Q: Which format should I use to save my images and videos?

A: The most common and universally accepted file formats for digital photography are JPEG (Joint Photographic Experts Group) and TIFF (Tagged Image File Format). The most common and universally accepted file formats for digital video are MPEG (Moving Picture Experts Group) and AVI (Audio-Video Interleaved). When you save your files in one of these formats, you can just about guarantee that the images or videos will be accessible to anyone who wants to view them.

Proprietary formats, such as those using the file extension .PCD (Kodak's digital photo format) or .MOV (Apple's QuickTime digital video format), are also available, but these formats may require special software for viewing. We suggest using one of the universally accepted formats, unless you have a particular reason for doing otherwise (as is the case if your video-editing application requires you to save your digital footage in a specific file format). Read your users manuals to determine whether you must adhere to a certain file format.

Q: How do I get my digital images or footage into my PC?

A: The transfer of digital data from a digital camera or DV camera to a PC is uncomplicated but fraught with potential problems. The first thing you need to do is read the users manual to determine how to connect your camera to the PC. USB (Universal Serial Bus) and IEEE 1394 (also referred to as FireWire or i.LINK) interfaces are especially popular these days, but your imaging device may connect to a parallel port or serial port instead. You must connect the digital camera or DV camera to the proper port to have any hope of transmitting data.

Once you connect the camera to the proper port, you may encounter problems with the transmission of images or footage to the PC. For more information about troubleshooting connection problems, see "Lights, Camera, Action . . . Uh-oh" on page 89.

On a related note, you should consider investing in a card reader for your digital camera or DV camera. A card reader acts and behaves like an external storage drive. You simply insert the camera's media card into the drive, and the contents of the card display on your computer. You then can drag and drop the images or video files into the folders of your choice.

Card readers sell for as little as $25 and connect to your PC's USB port. The card reader remains connected to the port at all times, and you insert the memory cards in the card reader only when you want to upload images or video files to the computer. Addonics (http://www.addonics.com), Imation (http://www.imation.com), and SanDisk (http://www.sandisk.com) are just a few of the many manufacturers that produce flash memory card readers.

Q: Can I take my camera through airport security?

A: Sure. The X-rays and metal detectors used at the airport checkpoints will not harm your digital camera or DV camera, but some of the security devices could damage the memory cards. The safest course of action is to stow the memory cards with your checked luggage or keep the memory cards in your pocket—put them in a protective sheath or container first—and let the security guards inspect them visually.

Q: What resolution should I use when taking digital snapshots?

A: The answer depends primarily on how you plan to display the images. If you intend to post your photos on the Web or in an email message, for instance, you should keep the resolution at a setting no higher than 640 x 480. If you intend to print your photos, on the other hand, you must use higher resolutions. We recommend a setting of 1,024 x 768 for 3- x 5-inch prints; 1,280 x 960 for 4- x 6-inch prints; 1,600 x 1,200 for 8- x 10-inch prints; and 2,048 x 1,536 for 11- x 13-inch prints.

The resolution determines the number of pixels the camera will use to capture a particular image. Obviously, a large image will require more pixels than a small image. That's why you need to adjust the resolution settings as the print size increases. But you don't want as many pixels when posting the images online because each pixel consumes several bytes of data. In this case, keep your snapshots at a low resolution so that your images don't bog down your—or your viewer's—Internet connection.

■ **All You Have To Do Is Ask.** The great thing about a trendy technology, such as digital photography, is that someone is always willing to discuss it. When you think of a question that concerns digital cameras or DV cameras, feel free to consult with friends, relatives, and co-workers who use the technology. If they can't help you, you can get plenty of assistance online. Start by visiting the Q & A Board at *Smart Computing*'s Web site (http://www.smartcomputing.com). Any question worth asking will generate multiple replies in no time. LS

by Jeff Dodd

From The Read-Only File

Books About Digital Cameras & Video

For more than 100 years, photography has been an exciting hobby, a satisfying avocation, and for some, a rewarding career. Now that photography has gone digital, the range of possibilities has expanded and more people than ever before are getting involved in the creation and manipulation of still and video images. If you're interested in profiting (financially or otherwise) from the marriage of computer and camera, you'll want to check out some of our writers' and editors' favorite books on the subject.

You can count on the "How to Do Everything . . ." series for solid information, presented in an understandable fashion.

■ **Still Photography.** "How to Do Everything with Your Digital Camera," by Dave Johnson (McGraw-Hill Professional Publishing, ISBN: 0072127724, $24.99). As part of the popular and well-written "How to Do Everything . . ." series, this book is packed with useful background information and helpful hints. If you're a digital camera neophyte, this is a great place to start.

"Teach Yourself Visually: Digital Photography," by Elaine J. Marmel (Hungry Minds, ISBN: 076453565X, $29.99). Another in a series of informative books, this one is an excellent introduction to the subject. Aimed at the novice, it features a lot of full-color illustrations and examples, which makes it definitely worth a look.

"Photoshop 6 Bible: Gold Edition," by Deke McClelland, Amy Thomas Buscaglia, and Mark Hamburg (Hungry Minds, ISBN: 0764535978, $64.99). Chances are, you'll want to edit and modify some your still images, and Adobe Photoshop is the tool most professionals use to do so. And when the pros have a question about Photoshop, this is the book they'll consult to find the answer. However, this book isn't meant for newbies; at 1,200 pages, it's an intimidating but excellent collection of tips, tricks, and intricate details about the world's most popular image-editing software. The Gold Edition includes two CD-ROMs packed with samples, utilities, interviews, and plug-ins. This book is a must-see for the professional or serious hobbyist.

"Paint Shop Pro 6 Power!," by Lori J. Davis (Muska & Lipman Pub, ISBN: 0966288920, $39.99). As an alternative to the intimidating (and expensive) Photoshop software, consider PSP (Paint Shop Pro), an image editor that's almost as powerful as Photoshop and available at one-sixth the price. Although PSP is simpler than its upscale competitor, it is still a complex and sophisticated application; and to get the most out of it, you will want a book that offers a thorough overview and detailed explanations of PSP functions and tools. This book is one of the best because it presents complex PSP techniques in a straightforward, easy-to-understand manner.

"Complete Digital Photography," by Ben Long (Charles River Media, ISBN: 1584500077, $39.95). This book primarily targets readers with some photography experience with its excellent overview of digital photography, making it ideal for seasoned film photographers who are contemplating (or have already made) the move to digital. To complete its focus, this book also covers the subject of editing digital photos.

Don't limit yourself to books about working in a digital medium. Publications from the masters, which includes any book by or about Ansel Adams or Andreas Feininger, are worthwhile investments.

■ **Digital Video.** "How to Do Everything With Digital Video," by Frederic M. Jones, Frederic H. Jones, and Jeffrey Wilson (Illustrator) (Osborne McGraw-Hill, ISBN: 0072194634, $24.99). Yep, it's another one of those "How to Do Everything . . ." books. There's a reason why this series is so popular: The books are easy to understand, thorough, and well-written. And this one is no exception. It's full of step-by-step instructions, great examples, and a wealth of information about video-shooting and editing techniques. It's perfect for neophytes, but perhaps a little too basic for more advanced PC videographers.

"Creating PC Video," by Douglas Stevenson and Robert Wolenik (Focal Press, ISBN: 0240803612, $29.99). A solid overview of PC-related video techniques. One of the authors runs a media production company, and the other edits a video magazine, so these guys know what they're talking about. Plus, it includes a helpful product appendix and glossary.

"Inside Windows Media: Learn to Combine Video, Audio, and Still Images to Create Streaming Media," by the Microsoft Windows Media Technologies Team (Que, ISBN: 0789722259, $39.99). As a guide covering a variety of technologies and techniques, this book is especially valuable if your goal is to create streaming video for a Web site. There's a definite Microsoft bias, of course, so don't count on a lot of discussion about Apple's QuickTime and other non-Microsoft technologies.

"Adobe Premiere 6 Bible," by Seth Greenberg, Adele Droblas, and Bruce Bowman (Hungry Minds, ISBN: 0764534564, $44.99). Adobe Premiere is probably the most popular video-editing suite for serious amateurs. It's a powerful and complex tool, and once you get beyond the basics covered in the users manual, you'll find this book a valuable reference.

■ **For More Information.** A ton of great books are out there about photography in general, and digital photography in particular. These are some of our favorites, but don't stop here. And for some great digital photography-related Web sites, be sure to check out "Our Picks To Click" on page 140. LS

Our Picks To Click

Sites About Digital Cameras & Video

Any Web search using the keywords "digital photography" or "digital cameras" will result in thousands of hits. That's a good indication of the burgeoning popularity of this medium and the underlying technologies. To help you narrow down your search, here are some of our favorite digital photography sites, broken down into digital camera and digital video sites.

Digital Cameras. The Digital Camera Resource Page (http://www.dcresource.com) is a treasure trove of information and knowledgeable opinions. The site, which has been online since 1997, includes industry news, tons of reviews, a decent FAQs (frequently asked questions) area, and a hugely popular message board. We found it to be a great place to dig for info about a particular camera or digital cameras in general.

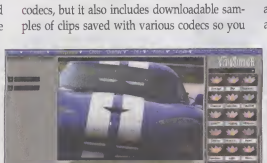
Looking for free photos? Check out Microsoft's Design Gallery (http://dgl.microsoft.com). Here, you'll find tons of clips, photos, and other artwork. The only catch is that they're formatted for Microsoft Office, so don't count on getting files you can use in other applications. Still, these graphics are great for adding a little pizzazz to your PowerPoint presentation.

And if you happen to be both a diver and a digital photographer, you'll want to visit the premier Web site for underwater digital photography, Wetpixel.com (http://www.wetpixel.com). The site includes news, reviews, forums, and a great gallery of underwater snapshots.

Originating in Tokyo, Japan, the Mar Scuba site (http://www.marscuba.com) is a plain, unadorned Web resource for English-speaking divers. It is, in a word, ugly. It's also very fast, very helpful, and full of useful tips about diving (although much of the site centers on, naturally enough, popular Japanese diving areas). But if you're interested in taking your digital camera underwater (of course, only with the proper equipment), there's a solid base of information here, including a handy table that lists cameras and the underwater housings that fit them.

There's a lot to be said for what we might call the Web-as-community movement. One example of that movement is the Internet Brothers site (http://internetbrothers.com), and one of this site's primary focuses is digital photography. Check out its tips about digital photography at http://internetbrothers.com/phototips.htm. These tips cover everything from purchasing a camera, to "gotchas" to avoid, to creating those cool virtual reality panoramas.

Digital Video. If you're interested in learning about codecs (compressors/decompresors), check out the CODEC Shootout site (http://www.codecshootout.com). Not only does this site feature a lot of data about the various codecs, but it also includes downloadable samples of clips saved with various codecs so you can judge for yourself which ones are best for your application.



Ulead's VideoStudio is a sophisticated but affordable video-editing suite for home users. The company's Web site includes tips and techniques for using this tool.

For a good general guide to PC video, check out About.com's Desktop Video site (http://desktopvideo.about.com). The site includes links to various PC-related video resources (Macintosh, too), including a myriad of how-to articles. About.com's video-editing page (http://desktopvideo.about.com/cs/howtoeditvideo) provides several links to information about editing tips and techniques, all presented in an easy-to-understand fashion. Visiting this portion of About.com to see if something interests you is well worth your time.

The Imaging Resource runs a Web site (http://www.imaging-resource.com) filled with news and reviews, links to great photo galleries, and more. In addition, the site boasts a huge collection of online forums discussing useful topics such as cameras, accessories, troubleshooting, and Q & A. All of this definitely makes this site worth a look.

The premiere home video-editing suite is . . . well, Adobe Premiere. At the Adobe Premiere Tutorials site (http://www.adobe.com/products/tips/premiere.html), you'll find numerous tips and techniques for using the product to create great videos. You'll need to sign up first for an Expert Center membership, but it's free and only takes a minute or two. The membership gives you access to specific details about using Adobe Premiere, as well as new plug-ins and other downloads. Very cool.

Our favorite home video editor (and much less expensive than Adobe Premiere) is Ulead's VideoStudio. At the Ulead Tutorials Web site (http://www.ulead.com/learning/learning.htm), the company provides online tutorials and tips that cover all the basics ("How To Get Video Into Your Computer," for example), as well as sophisticated video-editing techniques (such as "Creating Overlay Tracks").

As many Web surfers know, Tucows (http://www.tucows.com) is a great resource for shareware and freeware utilities, and the PC video domain is no exception. Just type **video**, **video capture**, or **video editing** in the search field, and you'll receive hits to hundreds of video-related shareware and freeware utilities, all of which have ratings from users and the Tucows editors/testers.

For More Information. Of course, these recommendations only serve as a good starting point for your digital imaging endeavors. (As always, we can't be responsible for content or images to which some of these sites might link.) But as you explore more online resources, you'll no doubt discover dozens of additional sites. And don't forget to see "From The Read-Only File" on page 139 for print resources about digital imaging, cameras, and video. LS

COMPLETE DISASTER!

TOTAL RECOVERY

Just a moment ago things were going great. Your figures finally added up, that critical report was done and your MP3s were downloaded. That was then. Now you're looking at a blue screen on a dead machine.

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Bluetooth—A technical industry standard allowing portable devices to interconnect with each other and with home and business devices. With a special transceiver chip, PDAs (personal digital assistants), notebook computers, cell phones, and other devices can connect with a short-range wireless connection. To install this technology, manufacturers must have their products approved by the Bluetooth Special Interest Group.

CCD (charge-coupled device)—An instrument with semiconductors arranged so the output (electrical charge) from one semiconductor is the input of the next semiconductor. This type of array is used as the light-detecting component in many digital cameras, video cameras, and optical scanners.

CMOS (complementary metal-oxide semiconductor) sensor—An electronic component used for RAM and fast data switching. CMOS semiconductors are made of two metal-oxide field effect transistors for high speed and low power use. However, they can be damaged by static electricity.

codec (compressor/decompressor)—Any technology used to compress and decompress data, which can be done with hardware, software, or a combination of the two. Different technologies perform this in different ways. For example, MPEG (Moving Picture Experts Group) is a video codec that compresses full-motion digital video; it requires special hardware for decompression.

CompactFlash—A type of removable storage card (also known as flash memory) for digital cameras. Many digital cameras accept CF cards, but others use a different memory type such as a SmartMedia card or a Sony Memory Stick. CF cards come in two varieties, Type I and Type II. Cameras designed for CF Type I can only use the 5mm-thick Type I cards. Cameras designed for CF Type II can use either Type I or the newer Type II (9mm thick) cards.

digital zoom—Most digital cameras aimed at consumers give users the option of using either optical or digital zoom capabilities. Many models offer both zoom types. Digital zoom is less preferable because it requires that the camera's embedded software only take a section of an image and magnify it to full size. Digital zoom is not a true zoom.

fps (frames per second)—A measurement of the speed at which a video switches from one frame to the next sequential frame to create the appearance of a moving image.

Memory Stick—Sony's thin solid-state flash memory module, measuring 0.11 inches thick by 0.85 inches wide by 1.97 inches long. Although Sony used Memory Stick in scores of its stylish gadgets from music players to the AIBO "entertainment robot," it wasn't until late 2000 that Epson, Lexar Media, and others pitched in with their own Memory Stick products. Sony's MagicGate is a copy-controlled version, and the Duo is about one third the size of the original Memory Stick.

optical zoom—In contrast to digital zoom, optical zoom is preferred by most digital photographers because it provides a true zooming range from wide angle to telephoto. Most consumer digital cameras have zoom ranges from 2x to 8x.

PCMCIA (Personal Computer Memory Card International Association) card—A credit card-sized device that plugs into a PC Card slot and lets the user add additional computer peripherals such as modems, sound cards, and optical disc drives. They are used primarily in portable computers but also can be used in desktop systems. Developed by the PCMCIA (Personal Computer Memory Card International Association), PCMCIA cards are also called PC Cards.

pixel—The smallest part of an image that a computer printer or display can control. An image on a computer monitor consists of hundreds of thousands of pixels, arranged in such a manner that they appear to each be connected. Each pixel on a color monitor comprises three colored (blue, red, and green) dots. The term comes from the words "picture element" and also is abbreviated PEL (pronounced pell).

resolution—The amount of definition and clarity in an image on a monitor or from a printer. In monitors, resolution is measured by the number of pixels the device can display. In printers, resolution is measured in dots per square inch (dpi) that can be printed on paper. Generally a user can dictate the number of pixels on a monitor, up to its capacity, by changing the display standards. In Windows, this capability is found in the Control Panel.

SmartMedia—A popular solid-state flash memory module used in MP3 players, digital cameras, and other gadgets. SmartMedia cards are very thin, at 0.03 inches, and are 1.46 inches wide by 1.77 inches long with a notch on one corner. This format is also known as the SSFDC (Solid State Floppy Disk Card), as it can fit in an adapter that slides into a PC's diskette drive.

solid-state device—A device with no moving parts, usually made up largely of electronic circuitry. Solid-state devices, such as transistor radios, are less likely to wear out than non-solid-state devices because there are no mechanical parts to erode by overuse. A CD player, on the other hand, has a motor that moves to spin the disc around for playback. Although it contains some solid-state components, a CD player is not a completely solid-state device.

TIFF (Tagged Image File Format)—(Pronounced tiff.) A common way to store bit-mapped graphic images on both PCs and Macintosh computers. TIFF is a platform-independent format, which means a TIFF image created on a PC can be viewed on a Macintosh, and vice versa. Bit map files, on the other hand, are a graphic format for the Windows environment. This format was specifically designed for scanned images and is commonly used for that purpose. It also can be used in some applications to save images created on a computer. TIFF graphics can be color, grayscale, or black and white. The file extension for TIFF images is .TIF.

white balance—A feature digital cameras have to correct colors in an image for different lighting conditions. In general, the camera finds a white point in an image and adjusts the other colors accordingly. Most cameras have automatic white balance, although many cameras have preset white balance settings for certain lighting conditions, such as sunlight or fluorescent lighting.

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